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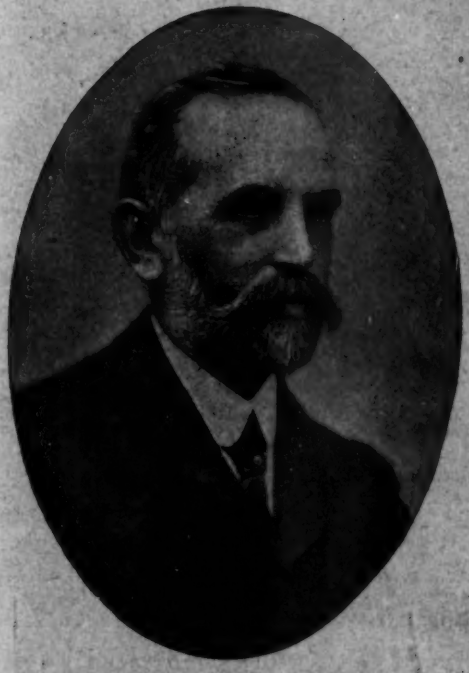

Mr. T. P. SYKES, M.A.,
President of the N.U.T.

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THE

PRACTICAL TEACHER

A MONTHLY MAGAZINE AND REVIEW

FOR THE SCHOOL-ROOM AND THE STUDY

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THE EDUCATION BILL.

THE draft of a statute that would withdraw from voluntary schools the anomalies of private management, but leave them as much of general Christian teaching and as much of specific theology as they impart to-day; that would "raise the bars" which have impeded the free circulation of teachers between school and school, while leaving teachers free to take upon their shoulders, voluntarily, the burden of specific theological teaching, if they like; that would deprive the parson of his "freehold" in the school, but lease it from him or buy him out; that would give parents in populous places a choice of schools according to creeds, but make the single school in a semi-deserted village undenominational and invidious to none—such is, in rough outline, the newest Government Education Bill.

Mr. Birrell is a picturesque figure: in face and almost in attire he might pass for one of Thackeray's heroes, as Millais drew them fifty years ago—Pendennis, Clive Newcome, and the rest. He brought to the Board of Education a powerful, acute, and humorous mind, uncramped and unbiassed by conventional training and antecedents. He let this mind of his play round the question submitted to his responsibility. He saw that a new compromise was needed, and he spied the lines of a compromise. Too witty and philosophical to be a bigot, too experienced as a Chancery lawyer to rely upon unworkable arrangements working, and too acute a politician not to know that the keys to the situation lay in the Irish Nationalist members' keeping and the keeping of the House of Lords, he set to work to devise a working arrangement which, while giving the majority in the House of Commons the things they had been elected to claim in this matter, would at the same time leave to the minority the essentials of their demand. What were these essentials, as expressed by their demanders? Certain rights of religious teaching of specific kinds in schools where that teaching had long gone on. The Bill offers that. If it had not done so, the general opinion of the country, which is Gallio-like as between party and party, Church and sect, would condemn it Mr. Birrell knew. If he could offer the essentials of the claim based upon doctrinal teaching, the claimants would be judged unreasonable at the bar of public opinion if they insisted on something else as well. The true skill of an advocate is not so much to put his client in the right as his adversary in the wrong.

Priest and parson had been demanding the right to continue their "definite dogmatic teaching." "You shall have it," said Mr. Birrell, and by saying it he disabled priest and parson from getting a verdict at the bar of public opinion for something more. It may have been the right to manage and "boss" the school that the parson or priest was also caring about, the honour and glory and kudos of being the domineer in the school. But he did not say that, dare not claim that, and so can be deprived of it, as long as his claims which are based on higher considerations are met.

The Bill meets them. Every priest and clergyman in the land associated at present with a voluntary school will have, if the Bill becomes law, the right to enter the school two mornings a week to teach and catechise all children of his flock whose parents wish them to be taught and catechised in that way. "The parents demand it," said priest and clergyman. "Very well, then; they will send their children for what they demand, and you shall be empowered to give it," answers the Bill. "If the children don't attend, it will be because the parents *don't* demand it — we shall see. But you must give it yourselves, not by deputy of teacher—the paid teachers must not give it, and it is part of your canonical duty to give it yourselves." Certain teachers had been meeting and petitioning that they wished to go on giving denominational teaching. "Well, you may," said the Bill, "if your school is in an urban region, where near it exists an undenominational school; but State or rate money

shall not be paid you for it. If you so much wish to give it, you will be willing to do it without public pay. But as the claim for this is based upon an alleged parental demand, it must be shown to be a real and sincere demand. Let us say, by four out of five parents who send their children to the school. On receipt of such a four-fifths demand the Local Authority may decide to allow dogmatic teaching in the schools five days a week, and you may volunteer to give it."

"But," say the priest and parson in the sparsely populated parishes, "*we* want it five days a week." The answer comes pat. "You know you don't give it five days a week now—you know that hardly any of you give it, by yourselves, once a month. You also know that not more than one-fifth of the time is occupied by the teachers whom you have appointed to do it in giving distinctive teaching different from what is legal under the Cowper-Temple clause. And you shall be empowered to spend two-fifths of the Scripture time in doing denominational work. But since the one school in your parish is *the* school for the children of all the parents, and no possibility of choice of school and dogma exists, the school must be for five days a week undenominational to all children whose parents wish it, and you shall cease to appoint the teachers because of their denomination—in fact, you shall cease to appoint them at all. On the other hand, it shall not be possible for the Local Authority to refuse you permission to teach in the school twice a week; but, also, as it must not be done in school hours, we will alter the school hours, making them commence after the religious lesson is done."

"But," cry the priest and parson, "they won't come to our lessons if they aren't compelled to." Answer comes pat again. "I thought you said the parents burningly claimed and demanded that your lessons to their children should be taught?"

"But we demand to enter the provided schools as well," say the clergy. "Why? On what justification?" is the answer. "The buildings were never yours; the cost of the provided schools was never yours. These are the buildings and cost of the public entirely, and as the public, though Christian as a whole, is not of one denomination as a whole, the religious lessons in them shall be common denominator lessons—not denominational at all." So, at every point, Mr. Birrell's clear, skilful, justified, and reasonable compromise holds the argumentative field.

Anybody can see in the Bill of 1906 the inevitable outgrowth of the Act of 1902; but only a few can see in them both the brains and hand of the National Union of Teachers—preparing, suggesting, guiding, skilfully bringing system out of chaos; demanding Local Authorities everywhere, large Authorities, one and the same Authorities, for elementary and other education; claiming that all the cost of education should be a public charge; and bringing the Bill of 1902 into the field. Then, when these things have been gained, going on to demand that public control everywhere should supersede semi-private management; that teachers should be emancipated from theological tests and from domination in school by clerical persons; that teachers should not be compelled to perform extraneous tasks, and yet not compelled to abstain from them; and getting all these, prospectively, in the Bill of 1906. What other brains demanded these things at the first except the brains of the National Union of Teachers? Demands which have become the commonplaces of politicians were first uttered at Conference and at Russell Square. The true source is forgotten, maybe, but not by everybody.

> "All can raise the flower
> Now they have got the seed."

Several years ago, at the Yarmouth Conference date, an article on the Cockertonizing attack appeared in the *Practical Teacher*. The article prophesied that great victory for the elementary schools and their developments, the Higher Grade schools, would emerge from apparent defeat. The prophecy stands already justified. But there is one clause of the new Bill which exemplifies the prediction still further. The Teachers' Register is to be waste paper. Just the same motives, almost the same official people, and practically the same methods as the Cockertonizing attack, were responsible for the Order in Council which drew the plan of an invidious, exclusive, and odiously snobbish Teachers' Register. The National Union of Teachers protested, but in vain. The Union bided its time, took its opportunity, used at the right moment and in the effective way its justified power; result, the Register topples down. Proof and witness, this, to the impracticability of continuing long a prohibition and inhibition arising out of professional unrighteousness; in these days, a Great Wall of China cannot be built for long between school and school, grade and grade, teacher and teacher. "A concession to an organisation of teachers which wields great political power" Sir William Anson, who tolerated the ill work done under Sir John Gorst, called this part of the Bill. At any rate, the Union wields its power openly; the Register was a backstair thing.

In the long run wisdom is justified of her children, but only when the cause of her children is right. It was because the cause was right, and the methods of bringing about its realisation were inevitable that the Union has obtained much, and is going to obtain more, of her programme of a National system of schools and teachers. Like Heaven, Parliament helps those who help themselves, but not those who "help themselves" in the greedy or larcenous sense of these words. When the Bill is an Act, the next thing to topple down like the Register will probably be the Chinese Wall built between the most experienced and able certificated teachers and the inspectorate. That is, if the Union still goes on, strong in the support of 60,000 members, who recognise the brains and the skilful hands which see its course ahead and direct it.

Empire Day, 1906.—Valuable suggestions for the keeping of Empire Day have been issued by the League of the Empire for the use of schools. An interesting new lecture has been published, called "A Trip round the Empire," from London to Liverpool, that is, round the world and back again in a special boat chartered by the League of the Empire. The lecture is a very suggestive one for teachers, and is divided into six sections of the different parts of the Empire. It can be given straight through as an Empire lecture, or the separate sections dealing with the different parts of the Empire can be specially worked up by the teacher. For celebrations the lecture can be illustrated by slides or sets of tableaux. The lecture, price 3d., may be obtained at the offices of the League, Caxton Hall, Westminster, S.W.

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THE SCARBOROUGH CONFERENCE OF THE N.U.T.

BY THE SILENT MEMBER.

SCARBOROUGH, *Easter Monday.*

SCARBOROUGH, like the milkmaid of legend, confesses, without a blush of modesty, that "her face is her fortune." "You are now, sir," says a portly burgess with prosperity writ large in the creases of his double chin and the rotund curves of his expansive waistcoat, "in the most beautiful town in the three kingdoms." He waves a fat hand at the prospect, and we hasten to agree with him, and even our Welsh friends, jealous for the honour of Llandudno, where we met under such pleasant auspices last year, are eloquently silent. Wonderful to state, a representative of the "Land o' Cakes" has no reservation; he uses the northern superlative, and remarks that it is "no bad." Certainly on this lovely morning, with a brilliant sun suffusing everything, a blue-flecked sky overhead, and the North Sea like a glassy pond in front, he would indeed be a churl who did not join in the general chorus of praise. I do not propose to describe Scarborough. That has been done, far better than I can do it, by the gentleman who wrote the account in the Conference Souvenir, which the publishers of this journal have had the honour and pleasure of presenting to the members of Conference. But this I will say. I have seen many pleasure resorts, both at home and abroad, and I know no single one where nature and art so happily combine. I defy you to produce a more delightfully varied series of pictures than those afforded by the amphitheatre of the South Bay. On the left you have Castle Hill, crowned by the ruins of its ancient citadel, and sheltering the little harbour with its fleet of fishing-boats and its coasting steamers. Squat and massive, yet dignified withal, stands the Parish Church, one step below the Castle, and thence seaward, in a huddle of picturesque red roofs, lies the ancient town, the nucleus of the modern borough, descending steeply to the sandy shore. Away southward the cliffs ascend as they curve round to enclose the bay. A great gully arcaded by lofty bridges, and backed in the far distance by the swelling Wolds, breaks the line of cliffs, and sharply descending to the shore are hanging gardens with sinuous walks and green lawns spangled with primroses. As you cross the iron bridges (after the ever-recurring payment of iniquitous tolls) you look into the hearts of the tall trees that shoot up from the valley, and see at close quarters the nests of the rooks that live in ample security within a few yards of the steady stream of passers-by. Here is a Conference in miniature going on. Raucous old birds in sombre black are addressing "a few remarks" to their seated comrades, while others are continually rising to or on points of order. A similar scene will be witnessed shortly in the Ground Hall of the Spa, to which we are even now wending our devious way.

. . . . . .

I do not remember a brighter and more promising opening to what bids fair to be a most momentous Conference. Twice before has the N.U.T. had the privilege of making the first great public pronouncement on a great Education Measure. Mr. Birrell's bill is like King Charles's head in Mr Dick's memorial—it cannot be kept out of the petition. Desultory conversations in hotel smoke-rooms—and where will you find more palatial and more comfortable hostelries?—impel one to the conclusion that in its main principles the Bill of 1906 commends itself strongly to the great body of expert opinion in this country. Details are keenly debated, but they are mainly on professional points. It would seem that the Government is to have the powerful backing of those who know the problem at first hand in all its manifold details.

. . . . . .

The Ground Hall of the Spa makes an excellent Conference Chamber. It is amply seated, lofty, light, and bright, though acoustically it is not quite satisfactory. The large platform fills up, and the crowded audience greets its favourites as they appear with that applause which is incense in the nostrils of public men. Now Mr. Mayor rises to voice the official welcome. He descants upon the unsurpassed beauty of the town (to doubt which is heresy of the blackest dye), and upon its antiquity. Their Vicar (who doesn't look it) goes back to Richard I., he himself is the lineal descendant of the civic magnate who first donned the ermine of his office in the twelfth century, and Mr. Russell Rea, M.P., who is one of the many youthful legislators in the present Parliament, counts his predecessors back to the latter half of the thirteenth century. The Mayor is exceedingly cordial, and the Conference reciprocates his compliments in the like spirit. Then rises Archdeacon Mackarness, *oculus episcopi*, who reads a gracious and politic message from His Grace of York—a message received with the heartiest applause. The Borough Member follows, and commends himself as "a product of Scarborough education," though a mere "ignoramus" on educational details. In supporting the new Bill he is greeted with the ominous cry of "no politics," at which some of us rub our hands in anticipation of "high jinks" to-morrow. But when he refers to the abolition of the Register, with its invidious class distinctions, there is a roar of approval. He wins equal applause in stating that the position of the transferred teacher must be fully secured, and in expressing his disapproval of Clause 34, which exacts seven years' service in the compound of a Local Authority where such an Authority has made grants towards the training of a teacher. Mr. Rea begs us "to give the Government a lead on this historic occasion," and I have no doubt that we shall do so, in the most unmistakable manner. His speech, on the whole, is thoroughly acceptable to Conference, and the applause which greets it seems to indicate that the conflict of opinion on the Bill is confined to a few clauses which the Government can modify without violating essential principles, or laying itself open to the charge of a "climb down."

. . . . . .

The Vicar of Scarborough (Rev. T. E. Lindsay, M.A.) follows. He is a man of presence, with a fine cultured face, and an ease and grace of language that captures Conference at the close of his first sentence.

Probably, too, many present are glad to have the opportunity of thanking him for the sympathetic words which he addressed to a crowded congregation of teachers yesterday. Very dexterously he avoids the burning question of the hour, and contents himself with hoping that the atmospheric conditions inside the Conference Hall may emulate those outside, that the temperate warmth of the weather and the clear sunlight may be emblematical of the spirit which will guide our actions and decisions. The Rev. W. H. Allen, on behalf of the Nonconformists, follows with complimentary phrases sincerely expressed, and then Conference settled down to hear an ex-Minister of Education, whose too brief régime at Whitehall is gratefully remembered by every representative whose hair is beginning to grow thin on the top.

. . . . . .

Mr. Acland gets a great reception. He gives us a full-dress speech, full of the wisdom of experience, and unwontedly overflowing with humour. He draws a happy parallel between Llandudno and Scarborough—to the latter's distinct advantage as respects scenery, educational fervour, and language. Animadverting on the old proscription which forbade a Welsh teacher to use the vernacular in his teaching of English, and remarking on the divorce of "school language" from the diction of the home, he told a good story. He met a Welsh boy in a country lane, and asked, "Are you, my child, in the Second Standard?" and at once got the reply, "No, no, sir! I am in Standard II."! In a more serious vein he turns to the question of co-ordination of all educational agencies—the universities are not in direct harmony with the elementary school, for example. There is too much examination even now, too much giving of diplomas and certificates. If he had his way, five-sixths of all the examinations for the conferring of diplomas and certificates should be discarded and deposited on the Dogger Bank, to the great advantage of real education. Commenting on the craze for diploma-granting, even after a three weeks' course, he quoted very appositely from the *Pilgrim's Progress* the experience of Ignorance when he was ferried across to the city by Vain Hope, and after a cross-examination was asked for his certificate, which, not possessing, "they bind him hand and foot and have him away." After a brief reference to the need for heightening, broadening, doubling, and even trebling the facilities for the training of teachers, and a Gladstonian anecdote to deprecate his tender of advice, he expresses the hope that in the dealing with the seventh clause of the Bill—the relation of teachers to "facilities," a point on which there is bound to be sharp conflict before the week is out—teachers will bear in mind the position of the local authorities. It is of the highest importance that they shall be able to make their appointments with equal impartiality, and be assured that the teachers in relation to their work will be absolutely fair to all, wholly disinterested, and free from bias. With this opinion we cordially agree. With an earnest plea that the teachers will help the bark of education across the stormy seas of dissension to a haven of peace, he concludes an address which, though longer than is usual on such occasions, is received with every mark of cordial approval, not unmixed with gratitude for notable services rendered to the best of all mundane causes.

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The platform is photographed. Mr. Mayor advises us to look pleasant, but when the operation is over does not add the exordium of the photographer who was operating on a lady of a very severe cast of countenance: "You may, now, madam, resume your normal expression." The photograph, by the way, we have pleasure is reproducing in these columns. Then comes Mr. Tom John—"the complete letter-writer," as Mr. Pickles aptly styles him later in the day. He voices our thanks with Keltic effusion, and is followed by Mr. Sharples, who, possibly with a recollection of his ecclesiastical functions yesterday, displays a pulpit manner which I have not observed before. But for all that he is forcible and pointed. His references to Mr. Acland are kindly and grateful, and he assures all and sundry who may "hae their doots" that the first care of the teacher in this crisis will be for the child.

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Mr. John, having sung his penultimate "Swan Song," clasps the blue riband of the Union about the neck of his successor, and Mr. Sykes, with the medallion on his manly bosom, takes the chair. Then comes the vote of thanks to the retiring President, and the way is clear for the reception of the delegates from sympathetic and cognate bodies at home and abroad. We hear a strong, virile address from Mr. W. R. Rae of the Co-operative Union. He gives us a significant hint that a concordat between Co-operators and Educators would mean a strong battalion of support behind a harassed teacher in the pit village or the industrial centre. Then comes a word of greeting from a representative of the Teachers' Guild, and a word of fraternal sympathy from M. Flamand, who represents the Association des Anciens Elèves de L'Ecole Normale et des Instituteurs et des Institutrices Laïques du Nord. (How the French revel in long titles!) The veteran M. Blondiau, on behalf of the Belgian teachers, delivers his address in excellent English, and perhaps even better is that of M. Lancée on behalf of the Dutch teachers. He is frankly an admirer of the N.U.T., and he gratefully acknowledges the inspiration which his Union has received from us. Mr. Fritsche, "the Swiss Macnamara," editor of the teachers' journal in the little republic of the Alps, and parliamentary representative for Zurich, speaks without notes in an exceedingly fluent and interesting manner. He is most cordially received by that conscientious minority of Conference which remains proof against the seductions of the sunshine and the shining sea. The Scottish representative, Mr. W. Service, President of the Educational Institute, delivers a capital address, and proffers tenders of goodwill and international brotherhood in well-graced terms. "Let there be," he says, "no jealousy, but let each honour and strive for the welfare of the other." Mr. John Nealon follows for the "distressful country"; Mr. Sykes briefly but adequately thanks the deputations, and we are once more outside in the bright sunshine, crossing the bridges towards Olympia, where an innovation awaits us.

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The publishers are well housed in Olympia, but again one hears the old complaint that to have Conference in one place and the Exhibition of School Books and Appliances in another is distinctly detrimental to the attendance of delegates at the latter. However,

the authorities do their best by inaugurating a formal opening, which is attended by an appreciative if limited company. The Exhibition, by the way, is fully representative, and bids fair to be more than usually helpful. A large number of directors of local educational authorities have been invited, and their attendance at the Exhibition will be eagerly welcomed by the suave and persuasive gentlemen who once a year find they have an abiding city for a whole week at a stretch.

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I need not deal with the afternoon session at length. Long before these lines are in print the President's address, the *pièce de resistance* of the occasion, will have been read and pondered over by the readers of the *Practical Teacher* in the pages of their daily newspapers. Mr Sykes's address makes no pretensions to high literary merit or to profound and abstruse argument. It is the plain, unvarnished story of a working teacher, face to face every day with the actual and real problems of education, rightly so called. He has some very pertinent remarks to make on the religious question, and his conclusions will be sure to commend themselves to his fellow-teachers. As a Bradford man he does not forget the Half-Timer, the youthful Helot of our industrial system. His address is very cordially punctuated with approving cheers, but his audience is not so numerous as it might have been. There are many "old hands" who take it as read. They prefer an afternoon in the open air, and a quiet perusal of the report in the evening paper over a post-prandial pipe. Some of that growing fraternity of the teacher-golfers find the Town Links a congenial venue for the exhibition of their powers or otherwise. The narrow, picturesque valley, with its furzy ramparts, its breezy heights, its "tricky" holes, its fine views of the smiling Wolds, with a glimpse of Flamborough Head thrown in, is very attractive, and many teacher-golfers from north, east, south, and west have "made their mark" upon its turf. Those faithful souls who take their Conference seriously, and sit every session out to the bitter end, are rewarded by hearing an excellent speech from Mr. Pickles, who has been elected Vice-President. Mr. Pickles, whom we cordially felicitate on his new and well-deserved honour, metaphorically applied a label which will stick to each of his predecessors in the vice-presidential chair.

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Tuesday Morning.

Rain has fallen in the night; the sky is clouded and the morning is colder, but if the atmosphere outside is a trifle arctic, within the Conference Hall it is distinctly tropical. By a few minutes to ten the hall is crowded with an unusually eager and expectant throng, for this morning we are to pronounce sentence on the Bill. There is a little interlude, in which Mr. Bevan, the capable and ubiquitous Secretary of Conference, pleads with us to take tickets for the excursions, which look like being a failure. I, for one, quite sympathise with those who find Scarborough all sufficient without day trips at the end of the week. Then come fraternal greetings from various bodies in conference assembled, the message from the Independent Labour Party being received with considerable applause. The results of the Executive elections are read out, and the way is clear for the resolution—"That this Conference expresses approval of those principles of the Education Bill of 1906, under which all public elementary schools, their teachers and managers, are to be brought under complete popular control, and under which creed tests are to be abolished." The Executive has entrusted Dr. Macnamara with the resolution, and indeed he is the central figure throughout the morning's proceedings. Quite early it is evident that he carries the majority of the delegates with him. His main point is that the Government has practically granted what we asked for at Cambridge in 1889. Conference then, on Dr. Macnamara's motion, approved with practical unanimity the principle of public support and popular control for public education. If words mean anything, if the resolutions of Conference are anything more than waste paper, we are committed to these very principles which appear in Mr. Birrell's Bill. It is in effect a logical outcome of the Bill of 1902. As to the creed test, it is simply a premium on hypocrisy, for you cannot command faith by Act of Parliament. Twenty thousand of the 74,720 teachers in public elementary schools still remain subject to the test, and its removal will have a healthy effect on the fibre and independence of the whole profession. Clause 7, sub-section 2, is the great charter of liberty for the teacher—a sentiment which is greeted with the heartiest applause, not, however, unmixed with cries of dissent. Dr. Macnamara's speech is strong, pointed, and business-like, and he obviously has won the day already.

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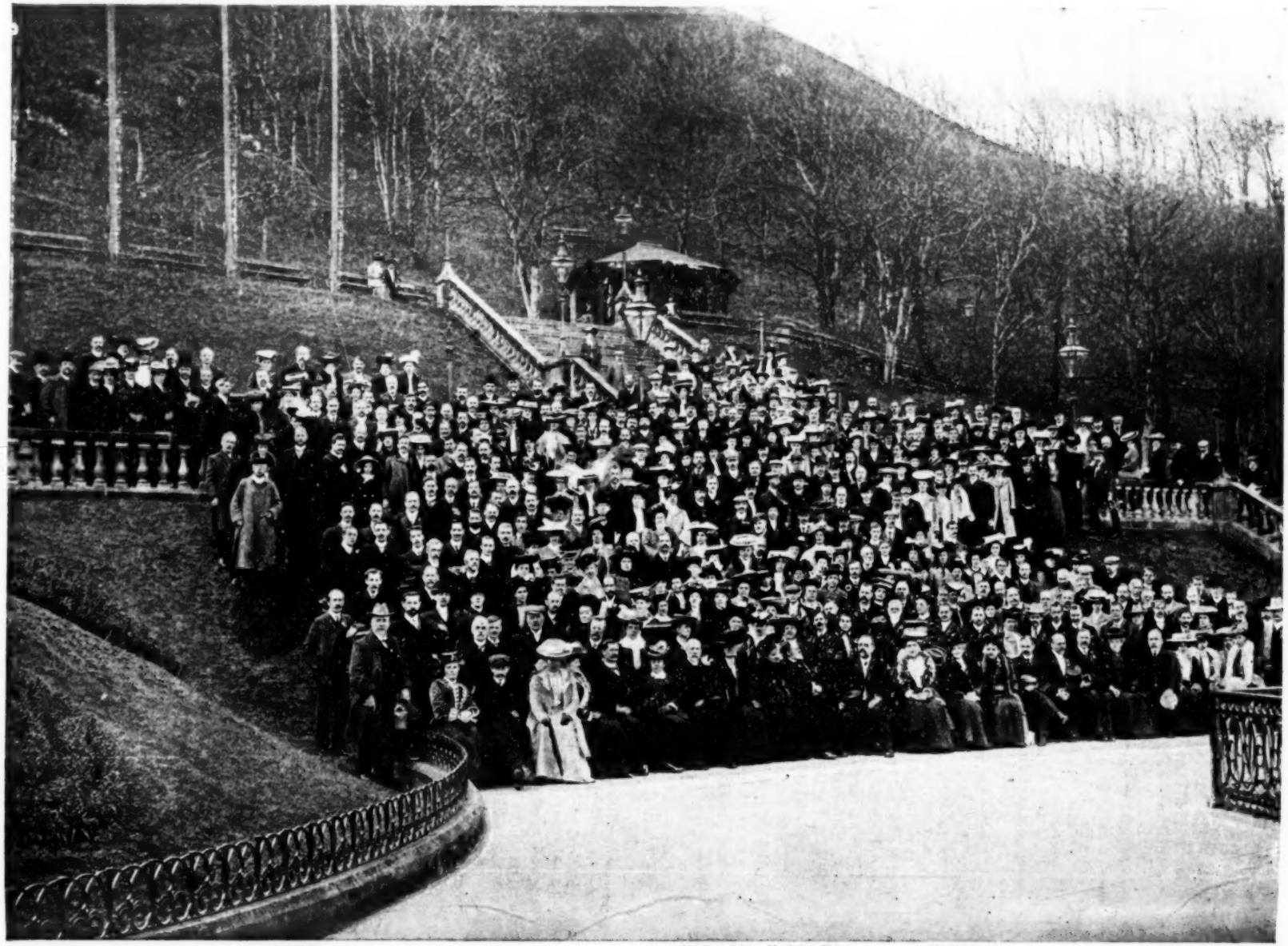
But the resolution is not to go unchallenged. As soon as Mr. Jackman has seconded in a word, and has reserved his speech in order to reply to the speeches of the opposition, Mr. Crowther of Bolton ascends the platform to put in the plea of the Church teachers. He is obviously nervous; he is conscious of the great odds against him; he knows that he is fighting a losing cause, yet he battles bravely, and we all think well of him for his manifest courage and fearlessness of statement. Mr Crowther asks that the "four-fifths schools" shall be retained as at present, and taught by a head teacher of the same religious faith as that which the parents profess. His speech is punctuated with interruptions, cheers, and counter-cheers. Almost his first statement—"I am a Churchman first and a teacher second"—provokes a perfect tumult, in which the supporters of Mr. Crowther make up by vigour what they lack in numerical strength. His contention is that if four-fifths of the parents are prepared to pay for denominational teaching, why on earth should not the school remain under the same control as at present? "This Bill," he cries, "is not Mr. Birrell's Bill but Dr. Macnamara's"—a statement greeted with laughter and applause, and a decided gesture of dissent from the mover of the resolution. Mr. Crowther speaks with great earnestness; his sincerity is unmistakable, but he is the leader of a forlorn hope, and he knows it.

Mr. W. J. Fleming, a Roman Catholic teacher from Oldham, seconds. He is a cultured speaker, and he, too, delivers his message with a depth of conviction that commands respect. But he, too, feels that the big guns are trained upon him. He is obviously wholly dissatisfied with what he calls the "common denominatory system of Christianity," and he denies that the Bill of 1906 is the logical outcome of public support for voluntary schools. The real logical outcome is secular education. Unhappily Mr. Fleming puts himself out of court, so far as Conference is concerned, by declaring that there can be no compromise



Mr. Ellery. Mr. Tom John, Ex-Pres. Mr. Sykes, M.A., Pres. Mr. Pickles, B.A., the new Vice-President.

A Conference Group at Scarborough.

(Photograph by H. E. Watkin, Marine Parade, Scarborough.)

on the question, as it is a matter of conscience, and the Catholics have a conscience, though they have not been so persistent as some in exhibiting it. The Bill will penalise Roman Catholics; it is born in turmoil, and will lead to reprisals.

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The temper of Conference is entirely to its credit. There are interruptions, of course—some of them a trifle unmannerly; but, on the whole, there is a broad, tolerant spirit, which gives a fair and attentive hearing to the unpopular side of the case. Mr. Jackman now intervenes. He speaks not as a Churchman, not as a Catholic, but as a member of the N.U.T. It is surely not for Unionists to plead for any denomination, whether Churchmen, Catholics, Nonconformists, or Freethinkers; the amendment is an attempt to splinter the Union into sects. As for Mr. Crowther's *non possumus* attitude, there can be no discussion if such a position is taken up. If there is to be no compromise, there can be no progress. Cowper-Temple teaching has satisfied the parents of our scholars for thirty years. Why depart from it? The amendment would destroy chances of promotion; it would continue the differentiation of salaries. In a word, it is wholly inimical to the interests of the teachers. The Bill would consolidate the profession as nothing else would do.

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Mr. T. P. Tregloghan, of Devonport, now ascends the platform to second the amendment. The Bill, he contends, will displace and confiscate the property of the Church of England and of the Roman Catholic Church. He pleads for the right of entry into the provided schools—a concession which the Conference will not have at any price. The Bill, in his opinion, imposes fetters on denominational teachers; it is a great and gross injustice to them. Mr. Hurden ardently advocates the system which works so well in the Voluntary School, and pins his faith to the article of belief which says that "all things necessary for salvation can be found in the Scriptures." Sectarian difficulties are a disgrace to Christianity. The Bill will enable citizens to love one another. Mr. Elliot, of Birmingham, follows in somewhat the same strain, and Mr. Hodges asks us why there is all this hubbub about denominational teaching in the Elementary Schools, when there is little or none of it in Secondary Schools? He finds Conference thoroughly in accord with him when he declares that "very dogmatic teaching" is not the rule even in Voluntary Schools, except, perhaps, on one morning in the week. What sort of dogmatic teaching can Pupil Teachers, unqualified assistants, and Article 68's give? Fancy propounding the "terminological exactitudes" of the Church Catechism to infants and the lower standards. There is considerable laughter as he declares that we are fighting a phantom, and that "this bogey only exists on the platform." Conference wilfully misinterprets Mr. Hodges, and enjoys its joke hugely.

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Mr. Rose, who comes next, begs those who have experienced both systems to give their verdict on the evidence thus afforded. He declares that no voluntary teacher who has ever applied for a post in a Council school can vote for the amendment. Thereby, he would be selling his "heritage" for a mess of pottage. Miss Felton, of Rotherham—the first lady speaker yet heard in Conference—believes that Clause 6 will enable the lazy parent to evade the religious instruction of his child altogether, and will afford an excellent opportunity for the lazy teacher to indulge his indolence—a conclusion which is certainly not endorsed by her audience. Then comes Mr. Rowcliffe, of Clitheroe, who is heard very impatiently, and has to struggle against persistent cries of "Vote! Vote! Agreed! Agreed!" He begs us not to let infidelity become rampant in the schools; but we do not heed him, for we are anxious that the question be now put. It is, and Dr. Macnamara rises to reply.

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He is exceedingly tactful. He recognises and respects the conscientious scruples of those who disagree with him. He deprecates the cry that this is a great crisis. Crises, like the poor, are always with us; but they have no terrors for him. Somehow the Union always manages to come out on the right side. The supporters of the amendment have not read and understood the Bill. Local authorities may grant extended facilities in the "four-fifths" schools. What Mr. Fleming probably desires is that the "may" of the Bill shall be turned into "shall." He will probably get what he asks; the Bill may readily be amended in this particular, but so far, and no farther. On the question of "tests" he will not yield an inch. He concludes by expressing his pained surprise at those who pour scorn and contumely on simple Bible teaching, which he always believed to be the common elementary basis on which all creeds unite. He beseeches us, whatever we may do, not to drive the Bible out of the school. The amendment is now put and defeated, and the resolution is carried by an overwhelming majority.

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We have blessed the Bill in its main clauses. The tension is over, and delegates begin to stream out of the hall. But Dr. Macnamara is again on his feet—it is his morning. This time he asks us to approve a resolution restoring an *ad hoc* educational body for London, and paying the railway expenses of members of Education Committees. Mr. Kelly seconds, and is evidently prepared to make an elaborate speech, but Conference has made up its mind, and after an ineffectual attempt to gain a hearing, he subsides, and the resolution is rushed through, and the session—the most momentous of the week—is over. Mr. Birrell will read his evening paper to-day with complete satisfaction. The remaining resolutions of the Executive are on minor and professional points, which will be pressed in committee. The teachers of England and Wales have declared the Bill to be educationally sound and practically workable. Undoubtedly it has moved a stage forward by our decision of this morning.

Tuesday Afternoon.

After a hurried hour for lunch, Conference assembles to deal with what the schoolboy calls its own "infernal" affairs. Domestic business alone is taken, and the gentlemen of the press are politely informed that their attendance is not required. I learn, however, that the report was under consideration, and that the question as to when the new rule making ex-Presidents District Members of the Executive shall come into force was keenly debated. Mr. Yoxall gets a well-deserved increase of salary, and Mr. Jackman, having obtained urgency, propounds his Superannuation proposals.

A Conference Group at Scarborough.
(Photograph by H. E. Watkin, Marine Parade, Scarborough.)

Tuesday Evening.

Tuesday evening is sacred to College reunions. In half a score of the many hostelries in this hospitable town bands of collegians forgather to renew old friendships, to smoke the pipe of peace, and to assure each other that the college to which they owe allegiance is the finest institution of its kind in the land. "The horse is the noblest of animals, and so is the cow," wrote the schoolboy essayist. Battersea is the first of training colleges, and so are Chelsea, Culham, Cheltenham, Peterborough, Westminster, and all the rest. The publishers' representatives also enjoy a good dinner and a merry sing-song.

Wednesday Morning.

There is a bright sun overhead, but withal "a nipping and an eager air," that forbids lounging on the front, and hurries delegates with upturned coat collars towards the Conference Hall. Out in the bay the white horses are tossing their manes, and along the deserted sands a solitary rider is galloping his pony and practising polo strokes. Conference meets at 9.30 ("owre early," some think), and there are many late comers. Mr. Waddington, an exile from the Executive, to which he was always a tower of strength, leads off with a proposal to add a clause to the Bill declaring that it will not be satisfactory as an educational measure unless it raises the age of half time to thirteen. Mr. Waddington has always been the friend of the Half-Timer, and the lapse of years has in no wise abated his zeal. He tells the old familiar and sorrowful tale once more — 80,000 little bond-slaves of industry, whose educational equipment is "cribb'd, cabin'd, and confin'd" by a permissive and pernicious system which is a standing reproach to the richest country in the world. He urges somebody to do something, and points out that a concern for the Half-Timer seems to be a passport for Ministerial office. Mr. Robson in 1899, and Mr. Sydney Buxton in the succeeding year, laboured in the cause, and look at their reward! Trade unionists urge an eight hours day; will they not take off the six hours of premature and paralysing toil from the little twelve-year-old worker? Mr. Whittick follows, and Mr. Smethurst succeeds, but both are preaching to the converted. Conference wants no speeches to command its sympathy, and at the earliest opportunity it carries the amendment unanimously, and even enthusiastically.

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Now we are on the stricken field of theological conflict once more. Mr. Croft desires a conscience clause in the training-colleges. It is, he tells us, the necessary and only corollary to the Bill. Thirty-nine colleges are still denominational, and thirty-two of them, with five-sixths of the total number of students in training, are only open to members of the Church of England. He knows of students who have become baptized and confirmed members of the Church of England in order to obtain that training to which they were legally entitled by winning a King's Scholarship. After commenting on certain statements made by Prebendary Brown of Carmarthen, he instances the case of two women students, respectively 237th in the first class, and 2681st in the second class; the latter was taken and the former left. The first-class girl could not enter the undenominational residential college for which she applied because it had already drawn its full quota from the students above her; she was robbed, for that year at least, of her training, while the second-class girl found a college without difficulty. There is something wrong here. Mr. Croft has a fervid disbelief in creed tests. "It is not what one says, but what one *lives*, that matters," a phrase recalling Sir Walter Raleigh's famous saying on the scaffold, when some one desired him to turn his doomed head towards the east—"What matter how the head lie, if the heart is right?" There must be a free provision of places, hence his resolution.

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Mr. Sykes interpolates an announcement that the lifeboat will be launched in front of the Publishers' Exhibition after the session, and that room will be found for six ladies. Who speaks first? The old cry, "Man the Lifeboat!" must be amended. Mr. Shawcross seconds Mr. Croft's motion, and is constantly interrupted by cries of "Vote! Vote!" Time is rapidly passing, and there are far too few speakers heard. Almost every man who has addressed Conference so far has had his time extended. It seems to me that Conference is losing one of its distinguishing characteristics—brevity, cogency, and almost epigrammatic statement of points. Speakers seem to indulge more freely in elaboration and decoration, and appear to strive to obtain an extension of time as a sort of testimonial to their oratorical efforts. That way deterioration lies. Conference in the future will probably do well in being far more chary of granting extensions.

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A lady delegate now rises to ask the speakers who are animadverting on the Church of England to be at least accurate in their statements. Somebody spoke of Nonconformists being baptized into the Church. Rebaptism in such cases is not required. "Once baptized, always baptized." Mr. Bentliff, who now mounts the platform, declares himself a "whole hogger" on this question, and moves an amendment designed to nationalise the training-colleges altogether. Mr. Lishman seconds, and then Dr. Macnamara intervenes. To sweep away the denominational training-colleges at a stroke, as proposed by the amendment, is indeed a large order, and it can't be done. Clause 7 of the Bill says that no "teacher" may be subjected to a religious test, and the code definition of a teacher includes the pupil teacher. In the future he or she will have no test during apprenticeship; but there will be a test when the time comes to enter a training-college. The anomaly cannot remain. Figures are quoted to show how relatively minute is the amount of voluntary subscriptions to training-colleges, and Dr. Macnamara remarks that even the college buildings have not always been erected with Church money. Referring to the case of the King's Scholars mentioned by Mr. Croft, Dr. Macnamara says we are spending our money on the wrong material. You may say, let other sects build their own colleges. But teachers will be wise not to encourage the establishment of too many colleges, and thus bring about an over-supply of teachers, with a consequent tendency to the reduction of salaries. You may also say that there are the day training-colleges, and that they are undenominational. But a King's Scholar who prefers the domestic system of the residential colleges, with its invaluable lessons taught by close association with

fellow-students, ought not to be penalised on the ground of religious belief. Dr. Macnamara concludes by pointing out the manifest advantage which will accrue to the Church if Nonconformists are admitted to Church training-colleges under a conscience clause. Excluded, they will be embittered against the Church; admitted, they may be influenced in its favour; they will be, at least, well affected towards the Establishment. Conference, he says, is rapidly becoming a confessional, but he, at least, is not going to declare what his religious beliefs are.

Mr. Cook supports the amendment, and Mr. Treglohan, a veteran gladiator of many Conferences, once more ascends the rostrum to do battle against the resolution in his usual sturdy way. "Dr. Macnamara," he says amidst the laughter of the Conference, "is always anxious when he sees me listening. I agree with him sometimes, but I differ strongly to-day." The burden of Mr. Treglohan's plea is that everything is going well at the colleges, and why disturb their present harmonious arrangements? "You say the Church has built many training-colleges. I say, all honour to her." Mr. Treglohan is frequently interrupted, but he has his supporters when he asks that the Church shall have fair play, and that the other denominations shall build colleges for their own students.

Mr. Croft replies. Nationalisation of the colleges is impracticable; we are suggesting amendments to the Bill; let us take one step at a time. The amendment is lost by a large majority, and Miss Broome takes up the parole in order to move the previous question. She is well received, particularly by the ladies. She denies Dr. Macnamara's remark that she is especially susceptible to clerical influence. She proceeds to point out that a conscience clause is not a panacea for all the ills; there are other hindrances to entrance to training-colleges not touched by the resolution—for example, health, lack of means, and so forth. She is astonished at the ingratitude exhibited towards the Church by those who owe their training to the Church colleges. Mr. West, of Leeds, points out that insufficient college accommodation is no fault of the Denominationalists, and asks why they should be blamed. He is subjected to a running fire of comment, and has not, I am afraid, much sympathy in the auditorium. The question is now put, and the amendment is defeated by an overwhelming majority. The fate of the resolution is no longer in doubt; it goes through with flags flying and drums beating. We have decided to amend the Bill by enacting a conscience clause for training-colleges.

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Mr. Blackburn moves a long resolution recommending that the local provision for education shall be materially reduced, and that a larger proportion shall be provided by the Exchequer, so that the local charge shall be as far as possible equalised. He is hardly on his feet before cries of "Agreed! Agreed!" are raised. Conference does not want a speech on the subject, and despite the appeal of Mr. Sykes it persists in crying down the speaker. He, however, sticks to his guns, and manages to fire off a considerable portion of his speech under most unfavourable conditions. When he makes the remark, "I will not weary you," he is greeted with a loud roar of approval. Mr. Mawbey seconds; he has a splendid speech, he tells us, up his sleeve, but he is a merciful man. The resolution—a pious opinion, by the way—is rushed through. We have no patience at this Conference for anything but the religious question, and not much for that.

Mr. Hole now rises to deal with a matter which, as I have already indicated, is productive of a sharp difference of opinion between the two unequal sections which have been at warfare since Conference began. Shall the teachers in non-provided schools be permitted to give denominational teaching, or shall they not?—that is the question. The Executive and Mr. Hole say "No." Mr. Crowther and his followers say, "Most distinctly 'Yes.'" Mr. Hole makes out an excellent case. At the outset he pleads that the previous question "be *not* moved." "Don't," he says, "let us have any Stanleys on this Bosworth Field. Don't adopt the pusillanimous position of allowing other persons to decide this question for you. This is a professional matter; we are not specifically trained to impart dogmatic teaching. Let those do it who are so trained. The 'may be permitted' of the Bill will transform itself into the 'will be persuaded' of actual practice. It is veiled compulsion." At this there are antiphonal cries of "Yes, yes; No, no"—strophe and antistrophe—until Babel supervenes. He goes on to give instances in which a coach and four is even now driven through the Act of Parliament. Thus permission will become persuasion, and persuasion will become compulsion. He reminds us of the Vicar of Scarborough's appeal fastened to the doors of the Parish Church on Sunday last. It calls upon Church teachers not to propose that religious teaching be destroyed, and not to permit buildings to be handed over to the Civil power, or words to that effect. He has little difficulty in showing the misleading character of the placard. The Bill is eminently just. At this he is pulled up on a point of order. He is certainly wandering far from his specific point, but it is difficult to avoid covering the whole field in a resolution which practically involves it. Mr. Hole does not get an extension, for precious minutes are fast slipping away; and even now it is perfectly evident that the resolution will be talked out—a fate which will probably not be deplored even by the Executive, which is notoriously divided on this question.

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Mr. Coward seconds, and Mr. Crowther, perfervid and in deadly earnest, is ready with an amendment. In a series of strikingly oratorical sentences he puts the case for absolute liberty of action. He is loudly cheered as he asks, "Who are you that dare say, 'You shall not!'" The applause is prolonged, and I venture to predict that if the question goes to a vote it will be adverse to the official resolution. Mr. Crowther's cry is, "Liberty for the teacher!" "Do you say to me, 'You are a citizen; you are a ratepayer: but because you are a *teacher* (here he suits the action to the word), shut your mouth!" With an impassioned appeal for "Equality," Mr. Crowther concludes, amidst a very storm of applause. Mr. Sharples seconds in a similar strain. He stands for the sacred word FREEDOM!!! Something has been said about striking off the last fetter from the wrist of the teacher. Why, this resolution puts on a whole chain! We ask for absolute liberty; you suggest slavery." Conference is now wrought up to the very highest pitch of excitement, but the time for opposed business has expired and no

vote is possible. The inevitable closure is resented by many, but there is no help for it, and the wisdom of Parliament must now decide.

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In obedience to a new standing order moved by Mr. Cook, who has been much in evidence during the week, a batch of unopposed resolutions—very old stagers some of them—is rushed through. We agree to forty children as the limit of a class under a certificated teacher; the corporal punishment resolution is reasserted; we strongly object to gambling, and so forth. Then we turn to the votes of thanks. The fiery cross is extinguished, and amiability and gracefully expressed gratitude displace the vials of wrath. We thank the Mayor and the Corporation, and hear with unfeigned pleasure the kindly and courteous words of Mr. Goodricke, the manager of the Cliff Bridge Company. The local conference officials receive evidences of our unstinted gratitude, and we empower the Executive to present the Chairman (Mr. W. R. Drummond) and the Secretary (Mr. J. W. Estill) with illuminated addresses, as a testimony to their excellent work, now so successfully drawing to a close. Various other votes of thanks follow; Mr. Drummond, Mr. Estill, and Mr. Bevan, the courteous and indefatigable editor of the souvenir, reply. Mr. Messetger expresses his pleasure that Oxford is to entertain us next year, and assures us that the 1907 Conference will in no whit fall short of that memorable gathering, held in the Old University city twelve years ago. And now we thank our old friend Mr. Tom John for his services as President, and present him with an illuminated address, which will be for many a long year to come the pride and joy of Ceinfan, Tonypandy.

Wednesday Evening.

We are in private session again, and once more gentlemen of the lay press are granted an afternoon's holiday; for which, no doubt, they are duly thankful. I shall deal with the general work of the private sessions later. The evening is delightfully occupied with a very largely attended conversazione in the Conference Hall. All the notabilities of the town and district attend; there is some excellent music; short speeches are delivered, notably one from Mr. Ellis, M.P., and those who are anxious to "see snakes" are enabled to do so in an anteroom, where Mr. W. J. Clarke, F.Z.S., exhibits a python and the largest living boa in Europe. One item of the very attractive programme claims special attention. Mr. Charles Howdill, A.R.I.B.A., of Leeds, gives a most interesting exhibition of Natural Colour Photography. He traces the progress of the art in a very lucid and interesting manner; but his pictures are the feature of the exhibition. For the first time many of us see lantern slides which are faithful reproductions in colour, tone, and intensity of natural objects and standard pictures. The "three-colour" process of printing is now generally understood by teachers. Mr. Howdill's slides are made on the same principle. The work of preparing such slides, he tell us, is difficult and troublesome, but the results seem to be worth all the labour involved. Four pictures from Messrs. Thomas Nelson's new Readers, specially reproduced for the occasion, are exhibited; and the effect, everybody agrees, is admirable. Mr. Howdill's contribution to the feast of reason and the flow of soul is highly appreciated, as it deserves to be. I congratulate all concerned on a delightful entertainment, in which there is perhaps only one drawback. We are entertained a little too much. Future conversazione secretaries please note—we *do* love to have long, long intervals for conversation. Most of us only meet once a year, and the topics of a twelvemonth are inexhaustible.

Thursday Morning.

Once more bright sunshine and pleasant airs. Scarborough welcomed us with smiles; she frowned a little yesterday, but to-day her humour is gay in the extreme. She gives us a foretaste of her bonnie face in June, and we are gallantly grateful. At 9.30 Conference goes into private session.

So far, I have said little or nothing of the private sessions. Let me now sum up briefly the general trend of domestic discussion during the week. The private sessions have been quite as strenuous as any of those former days, when the Union was in the making; but, fortunately, there has been no sign of the rancour over trifles, which at one time made some of us rather ashamed of some of our colleagues, and alarmed for the future of the Union. I thought Mr. Jackman's "object lesson" on Superannuation extremely lucid and telling. It was the subject of much favourable comment, both on the Spa and in the hotels; and probably it will be much canvassed in every association throughout the country. Perhaps the most interesting debate was, as usual, on the financial question. After the Report had been amended in the direction of practically censuring the Executive for not doing as they were told last year—viz. report on the best means of dealing with the excess of expenditure over income—Mr. H. R. Morrell of York moved a further rider which called for a Special Conference to consider both Organisation and Finance. It was evident that some members of the Executive did not like the idea. They came forward and urged that a big Conference such as was suggested could not profitably discuss finance. The Conference, however, was determined that something should be done, but misgiving supervened when Mr. Jackman pointed out that if the amendment were passed as moved, the "Special" Conference must, according to Rule 14, be composed of exactly the same people as the previous Annual Conference. A tangle seemed inevitable, but the General Secretary, with his usual lucidity, pulled things straight by pointing out that the whole difficulty was simply a matter of phraseology, and Mr. Morrell, promptly seizing the point, asked leave to alter "Special Conference" to "Special Meeting." This was done, and on a show of hands the amendment was carried. A division was claimed, obviously for dilatory reasons, but the result was equally decisive.

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Now we come to Thursday morning. The President makes a suggestion that the Special Meeting shall consist of a few selected people, and the motion in this form is carried, Conference evidently being very anxious to discuss the subject of Sustentation. Mr. Sharples, for the Executive, moves an increase of two shillings per year in the subscription, for the purpose of forming a Sustentation Fund. He makes a great

impression by detailing some of the cases which the Executive has had in hand, and which can only be properly solved by the resources of a big Sustentation Fund. Mr. Flavell's speech in seconding is admirable, but it is quite evident then that the question is settled. However, Mr. Cook of St. Pancras and Mr. O. Dixon of Hackney come up smiling with the Previous Question. They almost threaten the Union with the loss of the London members if any increase is demanded. The Previous Question, however, is lost on a show of hands, but a division is claimed. The President, anxious for a definite vote, says he will take the division on the main question. This is done, and the increase of subscription is carried by 32,006 to 12,193. So, ladies and gentlemen of the N.U.T., your subscription for the future will be increased by an annual florin. Many unopposed resolutions are then rushed through, and Conference closes with a cordial vote of thanks to Mr. Sykes. And well he deserves our thanks. He has had a skittish team to drive, but he has proved himself an accomplished whip. He has kept a tight hand on the reins; he has shown that he knows the road along which we are travelling; he has allowed no jibbing; he has been up to time, and the coach has gone on from stage to stage without the shadow of a mishap. So, before the ostlers take out the horses and the coach is run into the yard for another year, let the guard behind blow a lusty fanfare in honour of Sykes of Bradford.

Thursday Afternoon.

Conference is practically over, the rest is "leather and prunella," and the scribe must pack his bag and hie away. The time has come to settle his reckoning and receive "the Bill, the whole Bill, and nothing but the Bill," which being discharged, he is free to depart. He cannot stay for the reception of purses—a function which concludes every Conference, no matter how bitterly controversy may rage during the week, with the sweetest spirit of Charity. Lord and Lady Londesborough are to lend their countenance, and I dare venture to affirm that Mrs. Burgwin will again delight her many admirers (amongst whom the faithful scribe is enrolled) by the gracious eloquence of which she is past-mistress. Neither can he make one of the merry company which will foot it into the "wee sma' hoors" at the Ball. Nor can he join one of the many most attractive Excursions announced for to-morrow. Time and the printer's devil wait for no man. So doffing his cap in simple gratitude for a stimulating, happy, and healthful week in the "Queen of Watering-Places," *The Silent Member* bids his patient reader—*au revoir* till Oxford.

BY MANY HANDS.

"Quot homines, tot sententiæ."

N.U.T. NOTES.

THE Board of Management of the Teachers' Provident Society acts wisely in giving the fullest possible information to all interested, in its admirable little brochure, *Quarterly Notes*. The editing must, I feel certain, be a labour of love, so thoroughly is Mr. Arthur Golding's existence bound up with the success and prosperity of the "T.P.S." By far the greater part of its continued progress is due to his unremitting zeal and incessant labours, and I suppose he will never be entirely satisfied until its members' roll and that of the Mother Union are about the same. Thirteen years ago, as a matter of fact, he performed the whole of the work of the Society *single-handed*. To-day there are fifteen individuals engaged at the Central Office, and the number of letters now dealt with averages 113 per working day. By the very small margin of 31 members only, the Society missed its goal in 1905. This, however, does not prevent the Board from attempting a still bigger feat during the current year, the motto being "3000 for 1906." As the editor somewhat paradoxically remarks, "To stand still is to go back;" yet the truth of the dictum is evident. With an increasing army of teachers, and a correspondingly augmented membership of the Union, the Society simply *must* go forward. With an addition each year of 5000 young men and women to the teaching profession, to say nothing of a splendid mission field in the 40,000 Unionists who up to the present have failed to realise all that the Society can do for their benefit and advantage, it ought to be a simple matter to garner those 3000 new members. If each of the 320 local agencies would only do its fair share, success would easily be attained. Mr. Golding points out as a distressing feature that last year thirty-five local agencies were unable to forward a single fresh application. Wisely, he does not attempt to apportion the blame for this want of success, but there must have been astonishing apathy *somewhere*. The "contributed article," entitled "The Life Assurance Agent: An Ideal," is calculated to be helpful both to those who have taken up life assurance as their means of livelihood, and those who have not. The article will in all probability act as a spur and stimulus to the men who have crossed the Rubicon, whilst it may effectually prevent others falling a ready prey to the blandishments of the Yankee canvasser. I have seen so many (comparatively) of my acquaintances relinquish their profession for what seemed to be an "assured" competency, and then return to school like the proverbial "squeezed orange," that I am glad some one has had the courage to put in black and white the exceptional qualities requisite for this most difficult of all occupations.

"Quarterly Notes."

PERHAPS I am ultra-suspicious of any movement emanating from 83 Lancaster Gate, London, W., remembering that it was due to the Earl of Meath and his *dilettanti* satellites that teachers owed the intro-

duction of that egregious "model course" of physical training (save the mark!) now happily gone by the board. Therefore the coroneted missive which recently reached me—and probably thousands of my fellow-teachers about the same period—aroused no particular enthusiasm within my breast, although it was headed with the flamboyant words, "Empire Day." My own humble opinion is, that this "suggestions-to-teachers" business is becoming a little trite and overdone. We have one set of zealots advocating the compulsory teaching of the evils of alcoholism in our schools; another body of devotees say the laws of health and the prevention of tuberculosis are paramount in importance; and I believe Earl Roberts, K.G., V.C., &c. &c., has made a series of public pronouncements regarding rifle-shooting being taught to budding Britons. I admit, of course, the value of all these things, though, in my view, their tutelary saints would be wise to trust to the benevolent co-operation and good sense of the teachers in the schools, rather than to seek the introduction of their pet subjects into the normal curriculum. Personally, I somewhat resent the counsel tendered gratuitously by the amiable Earl of Meath that during the course of the year I should lay stress "on the training of the children in all the virtues which conduce to the creation of good citizens." Lest my intelligence should not rise to the heights demanded, Lord Meath devotes over twenty lines of a typewritten letter to showing how 'tis done. In a second letter he details the *modus operandi* of his "Empire Day" celebrations, and concludes with the paragraph quoted below, which appeals to me far more than does his "spread-eagle-ism":—

The Earl of Meath and "Empire Day."

> "Finally, the promoters of the 'Empire Day' movement are confident that those who take part in the celebration will utter no word which could give offence to any individual or nation, and, in any remarks they may make, will point out how much there is to learn from foreign nations; and how nationally suicidal is the stolid, self-sufficient pride which refuses to recognise the good points yet to be found amongst other peoples, and thinks it humiliating to adopt those which are worthy of imitation."

The suggested antidote to the "subtle approval of any such spirit" is Rudyard Kipling's noble and heart-stirring "Recessional" hymn, "Lest we forget."

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THE annual volume of an organisation which, at the close of last year, comprised 15,417 members within its 121 Associations, would at all times command the respectful attention of the teaching profession. The Handbook of the N.F.A.T., however (price 6d. post-free, from Mr. J. T. Boulter, Warwick House, Warwick Street, Leicester), deserves attention for its own sake; for crammed within its 112 pages is practically everything worth knowing concerning the remuneration and conditions of service of certificated class teachers under every Education Authority in England and Wales. With infinite care and patience Mr. Boulter has tabulated the various scales of salaries, and also calculated the amounts received under each Authority for the first fifteen years' service; so that an applicant for employment can see at a glance how the remuneration at one place compares with that of another. The figures and notes have been taken, in the vast majority of instances, from the printed scales and forwarded to the secretary for comment or approval. Things have changed since the day when salary scales were correctly described as "traps to catch the unwary," for I read this satisfactory prefatory note: "Inquiries have been made, and, *almost without exception, it has been found that Authorities adhere to the terms of their published scales.*" In addition to the fullest information regarding salaries, the volume contains short, well-written articles on all the points of the class teachers' "programme," amongst which are Confidential Reports and Log-Book Entries, Corporal Punishment Regulations, Staffing of Schools, Needlework Requirements, and A Conscience Clause for Teachers. An "open letter" to Students in Training Colleges gives friendly advice to each youthful Orbilius, and I was glad to see that the Executive of the Union had purchased 4000 Handbooks, in order to place one in the hands of every student whose college course terminates this year. I am personally delighted to possess, in handy form, the admirable address delivered by Mr. A. W. Dakers, B.A., at the Hull Conference. His principal theme was "Large Classes," and the re-publication of his soul-stirring appeal should serve as a trumpet-call to action to every teachers' association throughout the country.

The N.F.A.T. Handbook.

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'TIS now slightly over fourteen years since I made the acquaintance of Dr. Macnamara, so that one may—I suppose without presumption—claim to know *something* concerning the career and personality of the brilliant Radical member for North Camberwell. Early in '92 he had been appointed editor of the *Schoolmaster*, and with his new honours thick upon him, he came to Nottingham to address the finest public meeting I ever saw in the Midlands, his subject, oddly enough, being "Superannuation," and the *locale* of the gathering, the large theatre of the University College. Even at that comparatively remote date one admired and almost marvelled at the wonderful clearness and lucidity with which his facts were marshalled and his arguments presented; and, as every one knows to-day, his powers have increased and developed as he has climbed the ladder of fame. As President of the Union, at the Brighton Conference ten years ago, he was magnificent, although the representatives did (as he quaintly complained at the close of a memorable week) leave him "high and dry" over his Presidential address; and as a chairman of the Executive he has never, within my recollection, been excelled. He is ever the most interesting, if not the most picturesque, figure at a N.U.T. Conference; and the neophyte always returns home happy and contented if he has had the good fortune to hear a characteristic speech from the popular and redoubtable "Mac." Early in his public career he made his mark as a member of the London School Board, evidently determined to know as much concerning its work as those giants of past days, Mr. J. R. Diggle and the Hon. Lyulph Stanley; for in educational work, above all others, "knowledge is

Dr. Macnamara, M.P.

power." In the House of Commons his wide knowledge of the principles of each subject he referred to, as well as the astonishing amount of detailed information he seemed able to supply at any moment, won for him a reputation in that most eclectic of assemblies; and I shall always remember, with pleasure, hearing from a perfectly "outside" source—from Mr. Thos. Shaw, K.C., M.P., a prominent member of the present Government—how his supreme energy, his many excellences of character, his readiness in debate, and his aptitude for seizing the pyschological moment to speak, were impressing the House. It is no longer a secret that Dr. Macnamara was offered a post in the Government by Sir Henry Campbell-Bannerman, and that the office he refused was that of Parliamentary Secretary to the Board of Education—just the position of all others where he was best qualified to render the nation most efficient service. One cannot, of course, discuss the reasons for his decision, *coram publico*, but personally, I am intensely grieved because the capable Doctor took not the tide at the flood. The offer was worthy both of the Premier and Dr. Macnamara, and was a singularly high compliment to the integrity of the latter. I am glad to recollect that since this great chance was missed, the Executive have made such arrangements as will enable any member of the Union to whom office is offered to accept the same without apprehension as to the immediate or distant future.

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Confidential Reports.

I NEVER *could* understand the *raison d'être* of confidential reports; and after nearly a quarter of a century's work as certificated teacher, I do not propose to try. They have always savoured of "stabs in the dark," and are totally opposed to what we are pleased to describe as an Englishman's love of justice and fair-play. Very early in its history, the class teachers' national organisation set about procuring their abolition, and had no difficulty whatever in securing from the Conference of the N.U.T. an emphatic condemnation of their continued existence. Two years ago, at a private session at Portsmouth, a step beyond the "pious opinion" stage was reached, and Conference unanimously decided to regard the furnishing of confidential reports containing reflections of an adverse character as "a breach of professional etiquette," unless suitable opportunity were afforded of explanation or reply. Unfavourable references to class teachers in log-books, &c., naturally fall within the same category, and Conference has, on several occasions, decreed that all such entries should be shown at the time to the teachers concerned, who should be allowed to take copies of them. Personally, I am unable to see why such entries should be made *at all*. It is generally quite sufficient for a head teacher, who wishes to draw attention to delinquencies, errors, or derelictions of duty on the part of a colleague, to mention them orally; and in ninety-nine per cent. of the cases this method is effectual. Further, it should always be borne in mind that when a report is once made, even although a teacher may be able to offer a defence so complete as to secure full exoneration, yet—as an admirable memorandum prepared by Mr. Ernest Gray states—"there is always a risk, amounting to a practical certainty, that a memory will linger of a report having been made, of the teacher having been in trouble, even when the recollection of the result of the complaint shall have completely disappeared." Even at the risk of appearing to suggest the multiplication of "regulations," I think the code of every Education Committee ought to include certain instructions to head teachers, calculated to prevent the possibility of class teachers suffering any injustice. Our own "code of professional honour," plus the assistance of the Authorities, ought ere long to make of confidential reports and log-book entries only a memory and a name. A. C.

NOTES FROM THE NORTH.

Gartmore Dismissal Case.

WITH regard to the Gartmore Dismissal Case, dealt with at some length in last month's Notes, there is very little further to report. The Scotch Education Department informally constituted itself a Court of Appeal, and sent, on the 20th March, Mr. A. E. Scougal, H.M. Chief Inspector of Schools, to hold an interview with the School Board and Mr. Menzies. But, so far as the public are aware, little, if any, good has resulted from the intervention. A question was asked in the House of Commons with reference to the subject, but no satisfactory answer was given. I understand the matter is again to be brought up in the House, but I fear nothing will cause the School Board to rescind its resolution. The School Board Election, which will probably form the ultimate Court of Appeal, takes place on April 26th, and the teaching profession are looking forward to the majority receiving its quietus that day. It is a thousand pities that the professional future of Mr. Menzies should require to be vindicated at a public election, but from all reports the prospects are very encouraging. On behalf of the teacher and the parishioners favourable to him three candidates have agreed to stand, and I am led to believe that the present majority will be thrown out. In the case of the last dismissal case in Scotland, West Walten, in Caithness-shire, the School Board Election last week resulted in throwing out the majority, and though the Institute had removed its embargo against the Board, no teacher could be got to apply for fully two months after the dismissal. Scottish professional union is being thoroughly tested, and is standing the strain exceedingly well.

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The Scottish Education Bill.

THE prospects of any educational legislation for Scotland this session are exceedingly remote. Notwithstanding the formation of a Scottish party in the House, very little has been done to further the interests of Scotland. I have it on very good authority that there is something being done, but the wheels of the Government move very slowly. Mr. J. W. Gulland, the Secretary of the Scottish party, tried to get some indication of the area likely to be selected in connection with the forthcoming (when?) Education Bill, but was not very successful. I trust, however, that Mr. Gulland, who has always taken a

deep interest in Education, and who, by the way, is a member of the Educational Institute, will not rest satisfied with the somewhat evasive reply. It is hoped that when the Scottish estimates come to be considered something will be done to show the Government that the Scottish teachers are extremely anxious to have a Bill introduced, inasmuch as the question of tenure is becoming one of grave importance to the present teachers, and at the same time is militating very seriously against young people entering the profession. A deputation from the Institute recently visited London and interviewed several Members of Parliament, but the time seemed to be most inopportune, for the new Scottish party was busy in the throes of the election of their chairman. This was of vastly greater importance than the introduction of an Education Bill, with the result that the "policy of rebuffs" was the only one pursued.

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The Training Regulations.

NOW that the new School Boards have been nearly all elected, and the fires of criticism have somewhat exhausted themselves, rumours are rife that the final form of these regulations will soon be issued. Material modifications have, I understand, been made, and many of the objectionable features have been removed; so that there is every hope that the regulations when issued will meet with universal acceptance. The teaching profession will be raised, and a new stimulus will be given to youths of ability to enter the profession. The Department, though somewhat severely criticised, has emerged from the ordeal stronger. In many quarters, at first openly hostile, praise is being lavished upon the document. One result, however, may be that increasing efforts will be made to have the Scotch Education Department located in Edinburgh. There is much to be said for this. The close and intimate contact with the desires of the nation is greatly to be desiderated. There is a feeling that Scottish national opinion is being overlooked. On many questions it is considered that the Department has been somewhat slow to appreciate national needs. Schemes have been prepared in London which have been found almost unworkable in Scotland, and the consensus of opinion seems to be that Edinburgh should be the headquarters of the Department. In these days of rapid communication the opponents of the change cannot very well bring forward the plea of delay.

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The New Code.

FOR a number of years the changes in the Code have not been numerous, and perhaps this year there are fewer alterations than formerly. It was expected that the new regulations for the training of teachers would have caused a great disturbance, but the delay in the issue of these in their final form has resulted in the introduction of a note at the beginning of the Code. It says: "The subject-matter of Chapters III. and IV. and of the 1st and 2nd Schedules of the Code is at present under their Lordships' consideration, and consequently those parts of the Code are to be regarded as provisional only." These chapters refer to teachers and the training of teachers. I trust that there will soon appear the required changes, as delays are proverbially dangerous.

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General Aid Grant.

A MINUTE of the Committee of Council on Education in Scotland, dated March 19, 1906, providing for the distribution of the General Aid Grant included in the Parliamentary vote for public education in Scotland for the year ending March 31, 1907, directs as follows:—

£100,000 towards the making of grants in aid of capital expenditure for (1) providing buildings or equipment for the purpose of training teachers; (2) giving advanced technical instruction in a recognised central institution; (3) the great efficiency of special institutions, such as blind asylums, schools for the deaf and dumb, and the like, provided that the schemes be first approved of by their lordships. Applications should be lodged before May 1, 1906.

The remainder of the grant shall be applied in (1) making payments to the committees appointed under the minute of January 30, 1906, in connection with the training of teachers; (2) adding £25,000 to the amount allocated to County and Burgh Committees for Secondary Education; (3) in paying a sum not exceeding £1500 to those School Boards in the Highlands and Islands under the Department's minute of March 4, 1895; (4) in making a grant of £10 on account for each school attended by Gaelic-speaking children, on the staff of which there has not been at least one Gaelic-speaking teacher; (5) in making grants to schools with an average attendance of 75 or under, £40; schools of 125 or under, £30; schools of 180 or under, £20. These grants to be increased £10 each where the minimum additional staff stipulated for comprises at least one certificated teacher.

In this minute we have the first indication that the Draft Regulations for the training of teachers are to go by the board.

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Inspectors.

THERE has for several years been a growing dissatisfaction with the method of appointment of inspectors. I have had more than once occasion to refer to the subject in these Notes, and I therefore hail with satisfaction the fact that the Institute has prepared a Draft Memorandum on the question. The terms of the Memorandum are as follows:—

"The Educational Institute of Scotland, believing that the interests of education demand a close sympathy between teachers and inspectors, is of opinion that none but teachers of large experience in the actual work of school should be deemed eligible for the office of inspector. If it is essential that the teacher should be conversant with the theory and history of education, should have received a practical training in the art of teaching, and should know experimentally what the child can, and cannot, accomplish, it is all the more necessary that the examining officer, who not only estimates the teacher's work from certain measurable results, but discharges the higher and more difficult function of directing his methods, should possess

that familiarity with the teacher's problems which only the intimate experience of the teacher's training and the teacher's work can give. While cordially acknowledging the success with which, as a rule, the Department's inspectors have hitherto discharged their responsible and difficult duties, and admitting the necessity of appointing to the inspectorate gentlemen of high academic attainments, the Educational Institute of Scotland feels that the desirability of intimate practical acquaintance with school work on the part of the examiner has not invariably received full recognition, and would therefore express the belief that the inspectorate should be recruited from those who are qualified, not merely by their scholarship, but also by their success as practical teachers."

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Local Committees for the Training of Teachers.

WE are glad to note that Edinburgh has now fallen into line with the other universities of Scotland with regard to the establishment of Local Committees. Professor Darroch has been appointed Interim-Director of Studies, and applications from university candidates only are to be received. It is hoped, however, that the Committee's scheme will ultimately provide for the training of both university and non-university students. The work will begin in October next. We wish the movement every success, and if anything can be done to deserve success, we feel sure that Professor Darroch will do it.

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Congratulations.

ST. Andrews University has always favoured the teaching profession with regard to the degree of LL.D. Among its graduates are Dr. Macnamara, M.P.; Dr. Menzies, Ex-President of the Institute; and Dr. Lowson, a prominent member of the Stirlingshire branch of the Institute. And now to its list has been added the name of Dr. Watson of Dumbarton, a former President of the Institute. In conferring on him the dignity of LL.D., St. Andrews University has again shown its interest in the profession, and we venture to hope that Dr. Watson will long enjoy the honour. To Mr. S. M. Murray, Organising Secretary of the Institute, we offer our hearty congratulations on his election as a member of the Edinburgh School Board. His intimate knowledge of educational questions and his valuable practical experience will, we feel certain, prove of immense value to the education of that city.

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E.I.S. Doings.

THE Institute is once more face to face with the problem of Parliamentary representation. A scheme has been prepared by a committee, whose convener is Mr. Young, Ex-President of the Institute. This committee has chosen the county as the unit, and in view of the coming Education Bill there is every probability that this area will be the means of welding together many small branches, and making them a source of greater power to themselves and to the Institute.

With regard to the question of direct Parliamentary representation, the matter is still in the air. The "ca-canny" policy of a certain section may in the end prove the best, as before the present Parliament ends the payment of members may be legalised, and the number of teacher aspirants to Parliamentary honours may be so great that the difficulty will be not to find the man, but to determine who is to be left out. All the same, I think the Institute should now face the question seriously, and begin to lay aside funds for the purpose. The fruitlessness of the last deputation to the House of Commons emphasises the necessity for immediate action.

As I expected, there are to be no contests for the higher offices of the Institute. The election for the committee takes place in May.

Essays by Mr. Birrell.—Last month we reviewed the *Obiter Dicta;* now a new collection is before the public, called *In the Name of the Bodleian*—the title of the first essay, which is very characteristic. It points an excellent moral, which we make no apology for quoting:—

"Ignominious to relate, this glorious foundation stands in need of money. Shade of Sir Thomas Bodley, I invoke thy aid to loosen the purse-strings of the wealthy! The age of learned and curious merchants, of high-spirited and learning-loving nobles, of book-collecting bishops, of antiquaries, is over. The Bodleian cannot condescend to beg. It is too majestical. But I, an unauthorised stranger, have no need to be ashamed."

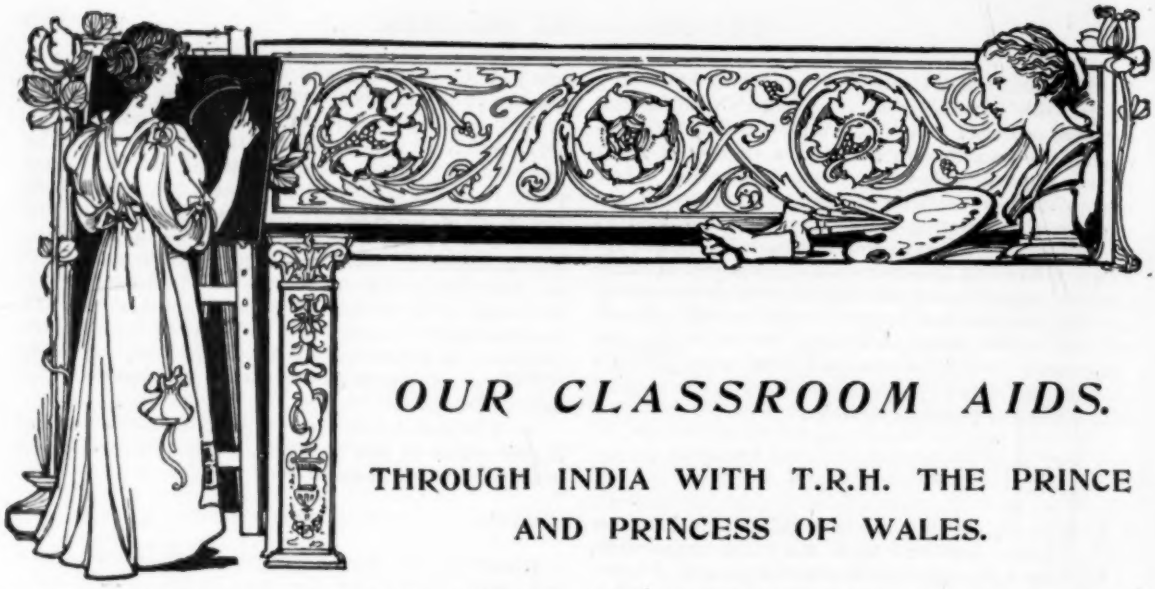
We remember that in a previous work, dealing with copyright, Mr. Birrell wrote:—

"If you wish to prevent your literary productions from becoming the prey of the cheap bookseller—if you do not want to be a 'penny poet,' or to be floated down to posterity as a 'Camelot Classic'—bequeath your copyrights to Oxford or Cambridge, and the chances are neither you nor your book will ever be heard of again. But the sepulture will be dignified."

This provoked the *Spectator* (the fiscal controversy had not then dawned) to suggest that Mr. Birrell must have fancied that he was in the rostrum of a Radical Debating Society. "Has Mr. Birrell," it asked, "ever heard of the Clarendon Press, which may be 'dignified,' but is certainly enterprising? Where would Dr. Murray have found a publisher for the *New English Dictionary* if Oxford had not taken up the enterprise?" This was quoted in the *Periodical*, and Mr. Birrell promptly wrote:—

"I was petrified with horror to find myself pilloried in the *Periodical* as a man capable of sneering at the Clarendon Press. I would as soon think of poking fun at the Parthenon. . . . What I had in my mind was not the supineness of the Clarendon Press, but the worthlessness of most copyrights—after the death of the authors of the books. Supposing Mr. Tupper had bequeathed his *Proverbial Philosophy* to the Clarendon Press, how many editions of it would have appeared after Mr. Tupper's death?"

Mr. Birrell inscribes on the title-page of *In the Name of the Bodleian*, a pious aspiration of Lord Shaftesbury's—"Peace be with the soul of that charitable and courteous author who for the common benefit of his fellow authors introduced the ingenious way of miscellaneous writing."



OUR CLASSROOM AIDS.

THROUGH INDIA WITH T.R.H. THE PRINCE AND PRINCESS OF WALES.

THE second journey through India led first to Mysore, the southernmost point of the tour. The State of Mysore is in the extreme south of the Deccan, and therefore has a climate less "continental" than most other parts of India. It has hot weather the whole year round, with little difference between summer and winter; also it has some rain, even during the winter months, and does not fear drought and famine as much as the more northern States of the Deccan. That is to say, agriculture is more thriving here; the coffee plantations are more important than elsewhere in India, and the forests yield teak and sandalwood. In mineral resources, also, Mysore is not poor, for gold especially is obtained.

One might therefore expect to find this a prosperous region with a dense population, nor is one disappointed, for the history of this State has contributed to its prosperity. For fifty years it was entirely in British hands, and the government was restored to the native rulers in 1881. During that period the British administration effected improvements, and paved the way for future progress, so that now there is much to differentiate this from most other Native States. This was evident when the royal party entered, for the reception lacked most of the medieval and picturesque quaintness seen both before and after. The town has well-appointed parks and good roads, a modern water supply and drainage system, educational institutions, and substantial-looking buildings. The gold mines of Mysore are of ancient origin, but they have seen great developments quite recently. The Kolar mines have now become very successful, and the machinery is worked by electric power derived from the Cauvery Falls. These falls also supply electric power for the lighting of Bangalore, the largest city of this State.

A short visit was paid to Seringapatam, eight miles away, on an island in the Cauvery River. It is a place of memories. Originally it was a Hindu city, and was conquered by Haidar Ali. He was allied to the French, and opposed the British; in a memorable battle the British were defeated, and several hundred prisoners were confined for three years in a small subterranean dungeon at Seringapatam. Haidar Ali was succeeded by his son, Tippu Sultan, who in 1799 was defeated and killed. Seringapatam was taken, and the British power in India was freed both from the ambitions of Tippu Sultan and the threatened dominance by France.

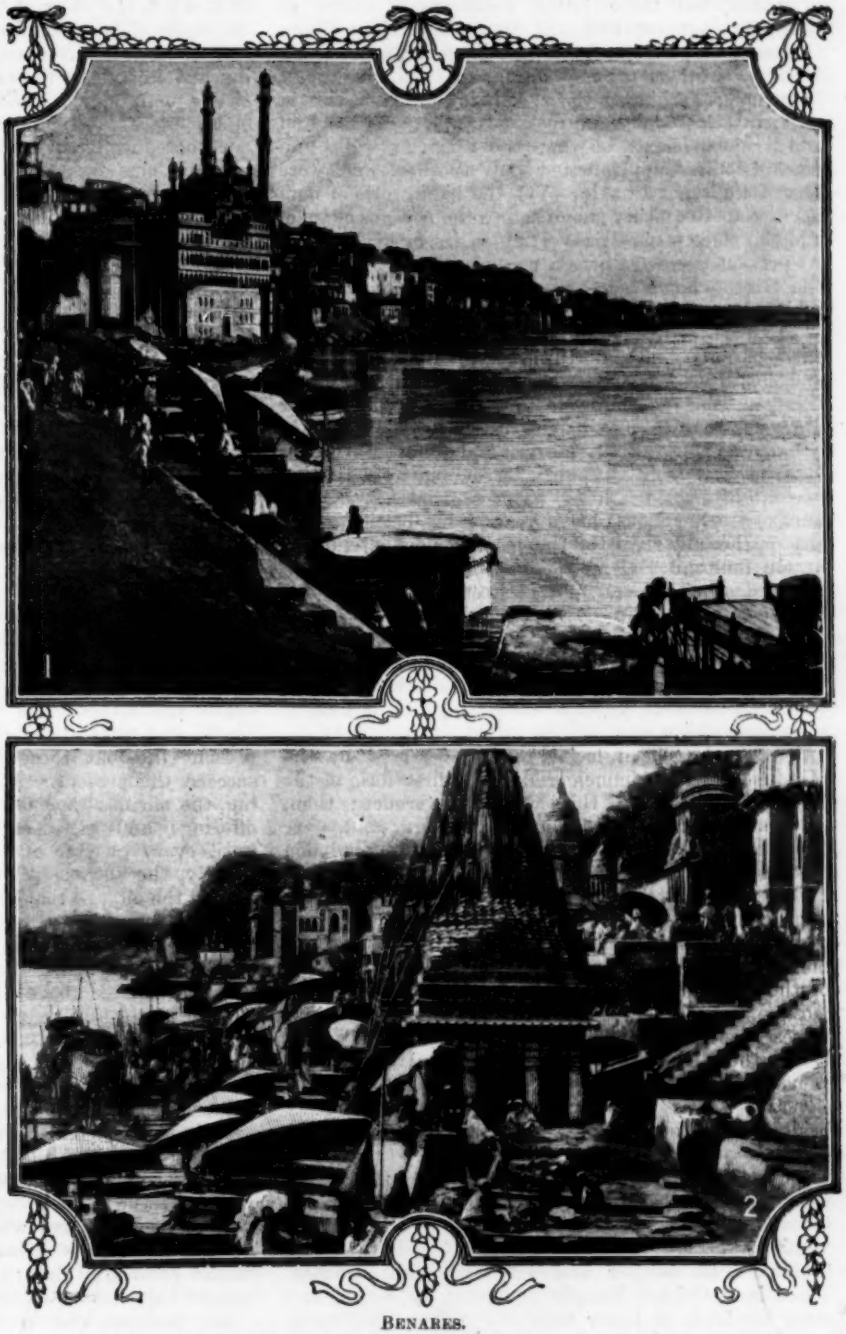
Mysore is a famous country for sport, which seemed, indeed, the chief object of the visit. The forests here are even yet the home of wild elephants, now becoming rare in India, and so for the Prince there was arranged a great capture of these elephants. They were driven by a large number of beaters, making a great noise and waving torches, through the jungles into the stockade or "kedda," where they were confined until they could be taken out bound with the aid of tame elephants traitorous to their kindred. Bangalore was the next stopping-place, but it had little of interest. It is a large British military station, healthily situated on a lofty plateau, but the only justification for the visit was the unveiling of a statue of Queen Victoria. It would have proved more interesting if, instead of Bangalore, some of the temples of Southern India had been visited. They are well worth seeing, being of Dravidian origin, and totally unlike those seen in other parts of the country. From Bangalore the journey was continued northward to Hyderabad.

The Native State of Hyderabad is quite typical of the Deccan, of which it is the heart. It is the largest of the native feudatory States, and once formed part of the Moghul Empire. One of the great soldiers of the Emperor Aurungzebe was appointed Viceroy, but formed an independent kingdom as the Moghul Empire broke up, and his title "Nizam" is still retained by the present ruler. Now the Nizam and a small proportion of the people are Mohammedans, but the vast majority of the population are Hindus. Nevertheless, the fact that the ruling class are Mohammedans gives many striking features to the life of the capital, and notably in the soldiery.

Not only the Nizam, but also many of the lesser nobles, keep their own armed retainers in quite the feudal style, and the Mohammedan element is expressed particularly strongly in this way. Arabs, wearing a fez, with a few daggers and pistols, and one or perhaps two very long matchlocks, are imported from Arabia, and go back after a term of service.

Africa sends a contingent in the form of coal-black negroes, but the strangest of these well-named "Irregular Forces" is the regiment of women quartered in the Zenana The Nizam has regular troops besides these irregulars; he also maintains a smart Imperial Service Corps. There are, in addition, the British troops, and the native troops of the British Government. Finally, the nobles have their odds and ends of troops more or less uniformed, and quaintly inefficient—survivals of the past kept up as evidence of social importance, but merely ludicrous in European eyes.

This heterogeneous soldiery is the most interesting feature of Hyderabad. It is the fourth city of India, with nearly half a million people, and is very much spread out. Like Madras, it is a city of great distances, and nearly all suburbs. The walled portion of the city has an area of about two and a half square miles, but the suburbs have an area ten times as great, and house most of the people. There was a ride of five miles from the station to the palace, but very little to see in all the distance. The palace itself, to which the Prince went to meet the Nizam, resembles the town in being greatly spread out and rather mean in appearance. It covers a quarter of the city proper, and has within its precincts several thousand persons, yet it is little more than a rambling mass of buildings, with little pretension to architectural beauty or even importance, and appears as meagrely appointed within as it does without. A new palace has been built in a good position a little distance from the city, but this holds out to the visitor no more attraction than the old one.



BENARES.

1. The Great Mosque of Aurungzebe and adjoining Ghats. 2. The Manikarnika Ghat.

Secunderabad is really a suburb of Hyderabad, and resembles it in being spread out over a great area. It is the largest cantonment of this part of India, and its extent is partly due to the difficulty of providing water for so many troops. The ground in this part of the Deccan is formed of very old and very hard crystalline rock, which does not allow water to sink into it. Therefore after rain, the water quickly runs off the surface, flooding the rivers, and soon there may be again a lack of water. All this part of India is dotted with tanks cut out of the hard rock, and it is especially in the Deccan, where this rock is found, that famine is most to be feared.

While the Prince was here he visited Secunderabad, and at a grand parade presented colours to a Rajput

regiment stationed here—a regiment that has a record of gallant service dating back more than a century.

Near Hyderabad is Golconda of diamond fame. The crystalline rock of this region yields both gold and diamonds, but these latter were never mined at Golconda, but cut and sold there in ancient times. Golconda used also to be a seat of government and a fortress, but there are now more ruins than buildings. Nature has fashioned the spot into a chaotic mass of rugged rocks, and man took advantage of this and added his defences, so that the artificial walls and natural cliffs supplemented one another, and were almost indistinguishable. Yet the handiwork of man has the more quickly submitted to the ravages of time, and the place is slowly reverting to its first condition. At present there are here a prison and the treasury of the Nizam, but its great neighbour, Hyderabad, has robbed it of almost all its importance.

From Hyderabad the Prince journeyed, with no stops of importance, northwards through the Deccan, and once again reached the low-lying, fertile basin of the Ganges. But, on coming to Benares, he saw scenes far different from those he had witnessed in Calcutta. For if Calcutta is essentially modern and almost European, Benares is essentially ancient and entirely Hindu; one might indeed call it "The Eternal City." For hundreds, even thousands of years, it has been the holy city on the holy river the Ganges, and now extends for nearly four miles along the left bank of the stream, bounded at either end of this stretch by a tributary flowing into the main river. The census returns give a population of 200,000, but the number of permanent residents is probably not more than 30,000 people, for the others are the pilgrims who visit this place in enormous numbers, perhaps amounting to a million in the course of the year.

Benares has been looked upon as sacred by the Hindus from time immemorial. The first form of the Hindu religion held this city in reverence; then, after many centuries, Buddha taught here; and, after Buddhism lost its supremacy, again the new Hinduism arose, and again Benares became the spiritual capital of India. Conqueror after conqueror has left his mark upon the city; seven hundred years ago it was desecrated, and many of its sacred buildings were demolished; later Aurungzebe razed to the ground one of the temples to Shiva, and in its place erected the mosque, with its four lofty minarets still lifting themselves proudly over the conquered city; finally, just before the British occupation, the Mahrattas overran Benares. The British occupation has not been destructive, but is very evident in the great railway bridge which here crosses the Ganges close to the city.

Although much of the glory has departed, the sacredness of the city has by no means diminished. What the temples lack in magnificence they make up in number. There are said to be 1450 temples, and thousands of smaller and less important shrines. There is a Golden Temple dedicated to Shiva, and some hundreds of lesser ones; for Shiva, the Creator and Destroyer, the Lord of Life and Death, is the central object of worship. Associated with Shiva is the goddess Kali; there are also the temples to dozens of other gods, the Monkey Temple, the Cow Temple, the Nepalese Temple—the list might be continued almost without end. Of course with the temples there are the Brahmins, *i.e.* the priests, devotees, fakirs, and men connected in innumerable ways with religious ceremonies or buildings.

Also there are many shops selling images of the gods, rice and flowers to propitiate them, or brass pots from which the water of the Holy River is poured over the heads of those who bathe in the sacred stream. The artistic work in silver, copper, and brass is an interesting and important feature of Benares, for which the city is justly famous. Especially is this so in the case of the brass work, in respect to which Benares is the most noted centre in India. One reason for this is the religious character of the city, and that the Hindus use brass utensils not only for ceremonial but also for domestic purposes—on the contrary, the Mohammedans prefer copper vessels. In this connection it must be remembered that the Indian frequently hoards his wealth in the form of silver ornaments, and likes also to show his prosperity by the metal utensils he possesses.

Above all there are the pilgrims, always present, but crowding into the city especially at certain seasons of the year. Since there is such a variety of temples dedicated to so many deities, the pilgrim can worship at these different shrines quite conveniently, whereas so to worship elsewhere would necessitate very long journeys. One pilgrimage to Benares may thus take the place of several other pilgrimages, and be considered as valuable as many visits, extending from one end of India to the other.

A very great attraction is the Ganges itself, here of especial sanctity, and to bathe in this water is generally considered as the chief aim by the pilgrims. They go down to the river at daybreak, to greet from the waters the sun which is seen rising in the east across the river. The water is poured upon their heads, and thus they are purified, not only for the present life but those lives which are believed to succeed the present. After the early morning bathing, the shrines each day are visited, the appropriate offerings and sacrifices being offered before them, until every quarter of the city has been traversed. Finally, the devout pilgrims will make a long tour around the city, so that these ceremonies and journeys frequently occupy many days.

To die at Benares, and to have one's body burnt on the Ganges bank and the ashes cast upon the stream, is desired above all else, for thus can the Hindu ensure being received by the great Shiva into his heaven. Hence the Burning Ghats by the river side. Here the dead are brought, and the bodies are laid down, those of men in white wrapping and those of women in crimson, to wait till a space for the funeral pyre is vacant. Then, with reverent ritual, the bier is placed upon the pile of wood (perchance, if means allow, of fragrant sandalwood), the fire is put to the pyre, and the body is consumed amidst the funeral songs of the relatives who sit around. Assured that the departed soul is in happiness, the survivors do not exhibit great grief, but rather resignation to the parting and hope for the future is expressed.

At Benares, the royal visit had little of an official or political character; that would have been out of place, and indeed almost the only evidence of it was the visit to the Maharaja. He still has a palace and social position, but no voice in the government, which for a hundred years has been in British hands.

The royal party proceeded from Benares to Luck-

now, and thence the Prince went again to Gwalior on another shooting excursion, accompanied only by a small suite. This expedition was very successful; H.R.H. bagged three panthers, nine tigers, and many other animals. A less pleasant incident was a visit to a famine relief camp, where several thousand people were provided with work in making a dam for irrigation purposes. Famine is fought by irrigation in two ways; the lack of rain may be met by water obtained in this way, and during very bad times the extension of the work affords work and subsistence for the labourers. At the time of the royal visit the rains had been disappointing, and there was considerable distress in parts, but this year has not been so bad as many others.

While the Prince was at Gwalior, the Princess took part in several excursions, the most notable being to Mussooree, which is 6000 feet up the Himalayan slopes. This visit was very short, but to some extent it compensated for the abandonment of the Darjeeling trip earlier in the tour. The Prince and Princess met again at Hathras, a railway junction just north of Agra, and stopping only one day at Aligarh, resumed without further breaks their journey to Quetta.

Quetta was reached after a journey of two days and nights. The railway skirts the Punjab, and runs south-east along by the Indus to Karachi. From this main line, a branch runs north-westward through Quetta right through Baluchistan to the Afghan frontier. The first part of this branch railway is through low-land, but the further part runs through very mountainous country, and here there are two different lines, forming a great loop. This is necessitated by the nature of the country.

The more direct of the two routes goes through the Bolan Pass and along the valley by the river bed. Very occasionally there is a heavy rainfall in the district, and the river is swollen out of all recognition, flooding the valley and rushing downwards with irresistible force. This occurred while the line was being built, and every trace of it was washed away; when it was re-made it was at a higher level, but even now it might possibly be damaged. The other route also suffers from the effects of rainfall, but in a different manner. The rain loosens enormous masses of clay, of which the mountains are in places formed, and there is then the possibility of an avalanche of clay burying the line. But these are not the only difficulties that may be encountered in reaching the frontier. Locusts may actually stop a train, not of course by directly opposing it, though their numbers are surprisingly great, but by their bodies making the wheels and rails so greasy that the wheels cannot "bite." Also there are snowstorms and snowdrifts, which may bring the train to a standstill. When the royal party came to Quetta there was snow on the mountains, and the view was obscured by mists. There had been a hailstorm just before, but the only inconvenience was that no public welcome was given.

Quetta is in a valley a few miles in breadth, and the bottom of this is so filled with fine débris that there has been formed a level, fertile plain. The valley is nearly 6000 feet above sea level, but it is overlooked and almost enclosed by high mountains, some of the peaks reaching 11,000 feet. Therefore Quetta enjoys no moderating winds from the ocean, and its climate is very extreme. The great heat of the summer is excellent for crops now that irrigation supplies the necessary water, and the neighbourhood of the town is a picture of fertility in the summer season, but this prosperity is quite recent, and dates only from the British settlement.

Quetta was built after Sir Robert Sandeman had concluded a treaty with the chiefs of Baluchistan in 1876. By this treaty the British overlordship was acknowledged, and the Khan of Kelat, the greatest of the Baluch chiefs, was granted a considerable income in consideration of various rights ceded to the British. At the present time Baluchistan has the same position with respect to the British Government that the Native States of India have; but British Baluchistan, which includes Quetta, and divides the independent portion into a south-western and a north-eastern part, is entirely in British occupation, and for this portion a quit-rent is paid.

The railway goes 120 miles beyond Quetta, aiming at Kandahar in Afghanistan, and the last station—on the frontier—is New Chaman. Several miles before reaching the terminus the railway pierces a great range by means of a tunnel, and the further extension to Kandahar is comparatively easy. The Prince visited this outpost, and while there saw the material kept in readiness to extend the line rapidly in this way should need arise. He also saw the plans by which troops might be quickly assembled, for the normal garrison is very small. It now consists almost entirely of the 127th Baluch Light Infantry, and to this regiment the Prince presented new colours.

Besides the route from Quetta to Kandahar, there has recently been re-opened an old caravan route from Quetta to the great oasis of Seistan to the west. This oasis was once known as the "granary of Asia," but its importance has now gone, perhaps some day to re-appear. There is not much trade, however, through Afghanistan to India, as the duties imposed by the Amir are so heavy; it is more profitable to send goods from Turkestan by way of Persia and the Persian Gulf.

Quetta is closely connected with Karachi, especially in military matters, for troops and stores destined for Quetta in time of war would be landed at Karachi, and sent on by rail. Bombay could not conveniently be used as a port of debarkation, for between it and the Quetta region there is the great Indian desert, crossed only by one railway. As that is of the narrow gauge, to use it would cause great delay in transporting everything twice over, from one kind of truck to another.

Karachi is necessary, therefore, on account of Quetta, but it has grown greatly since the Punjab has been developed and brought into railway connection with the sea. Hence the growth of the port has been recent and rapid, and made possible by improvements at the place itself. Fresh water has been obtained from a river entering the sea here, and irrigation has made the place habitable, with some claim even to prettiness. A harbour has been created, and the channel is kept clear by continual dredging. Yet Karachi, if expensive, may be considered a good investment, for already it has a great trade, notably in wheat, and its prospects are very bright.

Here the tour terminated, and this description may fittingly close with some words of the Prince when he replied to an address presented to him by the municipality of Karachi. He said, "Your concluding words of 'God speed,' for which we are both most grateful, remind us, alas! that our visit to India is near its end. I can assure you and our other friends in all parts of

this great and wonderful land, that we leave India with feelings of gratitude and affection. We have seen enough to make India a living reality to us, and enough to make us wish that we could see more, and to implant for ever in our hearts sympathy and interest in all that affects our fellow-subjects in India, of whatever creed or race. Although our receptions everywhere were scenes of brightness and splendour, and we have been greeted by thousands of cheerful and happy faces, we have not forgotten the hard lives led by those in the trying climates of the plains, and we know the miseries which beset the patient and hard-working peasant when the rains do not come in due season. . . . In bidding India farewell we can truly say that our visit has been to us an unending and unbroken series of happy and most instructive experiences."

A MAY-DAY RAMBLE.

BY P. HORN.

MAY 1st, 1905, was hardly an ideal May-day. For several days previous, the weather had been most unsettled; consequently, after toiling painfully up Kingston Hill in the teeth of a strong head wind worthy of March, I was not surprised to find myself compelled to seek the friendly shelter of a roadside tree, by reason of a sudden storm.

I had originally set out with the intention of journeying down the Portsmouth road to the breezy heights of Hindhead, for the purpose of initiating a young friend in the gentle art of fishing; but, when the downpour abated, the roads were no longer in a fit state to warrant my arriving in a presentable condition after a cycle ride of forty miles, so the journey was reluctantly abandoned. With a whole day before me, it seemed ridiculous to return home straightway. Hard by was Richmond Park. The naturalist can always be certain of seeing, and perhaps securing, something of interest in this well-timbered preserve; particularly in the way of bird life.

On the other side of the road, a short distance towards London, a notice-board, setting forth sundry misdemeanours and their penalties, marked the spot where the Beverley Brook emerged from the bird-haunted copses of Wimbledon Common. It was decided first to pay a brief visit to a certain little pond in the Park. Visitors cannot fail to be struck by the rookery near the Robin Hood entrance. On this particular morning, the sable inhabitants of the colony were in a great state of activity. Judging from the medley of weird cries proceeding from the ragged structures aloft, the young were well advanced towards the first stage of independence, when they lighten the labours of their patient parents by accompanying them to the neighbouring fields. Jackdaws were everywhere in evidence. It is noticeable that most of the cave-dwelling birds, such as the starling, jackdaw, and woodpecker, patronise the Park, probably on account of numbers of ancient hollow trees; but the ubiquitous and obtrusive jackdaw predominates, stuffing his collection of sticks, roots, and rabbits' fur into every available nook.

The jackdaw is an amusing bird at all times. He becomes supremely ridiculous when he seeks a wife.

One hoary-headed fellow, perched conspicuously at the summit of a dead oak, was bowing and chuckling, with half-spread tail, his head apparently distended to twice its normal size, oblivious of all save the object of his choice. Occasionally he varied his performance by gravely executing a sidling dance. Whether his clumsy wooing was successful or not is a matter of conjecture, for the quaint proceedings were brought to an abrupt termination by the sudden appearance of an envious rival.

Amongst other interesting birds seen and heard in the journey across the Park, were the woodpecker, mistle-thrush, tree-creeper, four species of tits, mallard, and heron. The latter birds form an old-established colony in one of the enclosed plantations, which, it is hoped, will not be thrown open to the public.

Quite a feature of the landscape are the fine old hawthorns, in the hollow stems of which the pretty little redstarts lay their blue eggs.

The pond mentioned lies at the far end of the Park.

It is interesting to note that from this self-same pool, which is barely forty yards long, several school aquariums have lately been stocked. Water weed grows here in abundance, anacharis, starwort, but more especially the beautiful milfoil, and early in March one may be tolerably certain of finding frog-spawn.

Caddis-fly larvæ, chiefly those which construct their tubes of pieces of rush placed crosswise, may be taken here by handfuls. They are most hardy in captivity, and, as I subsequently found, will utilise duckweed and pieces of the shells of the larger water-snails in default of the usual material. Higher up, where the little stream enters, another species, which builds a tube of sand, is found in sparing numbers.

Both species were collected, together with a few water-boatmen, snails, and a bunch of vigorous weed. The whole was temporarily lodged in a bait-tin, the legitimate contents of which were summarily ejected for the benefit of the birds.

The clear shallows are a favourite bathing-place for the birds. When they have finished spluttering in the water they adjourn, much bedraggled, to the sunny side of a convenient hawthorn, and rearrange their disordered plumage.

Leaving the birds to their toilet, I retraced my way back, *en route* putting up a weasel, which discreetly bolted beneath the gnarled roots of a tree, and in a short space of time I reached the outskirts of one of the most delightful spots in the south-west of London.

Up to the present Wimbledon Common has escaped the attention of the individuals who appear to imagine themselves competent to improve upon nature. As a consequence its chief charm lies in the variety of aspects which it affords. Heath, woodland, copse, streamlet, and bog alternate, and form a succession of pleasant surprises seldom found so near town. Needless to say it is a favourite hunting-ground for the naturalist; there is ample material of interest for the botanist, entomologist, or bird-lover who knows how to use his eyes.

A few water-voles still linger along the shaded banks of the Beverley Brook. Doubtless in the future, when the speculative builder annexes the neighbouring fields, they will be ousted by the commoner household pest, and we shall be compelled to go further afield to see the water-rat at home.

Wrens, robins, hedge-sparrows, tits, and other characteristic English birds, were enlivening the straggling copse by the Beverley with their various call-notes,

and somewhere near at hand a cock pheasant, probably a wandering bachelor from the coverts in the park across the road, crowed defiance, accompanying his challenge with a thunderous fluttering of wings.

The narrow strip by the brook is but a very small portion of this extensive common, scarcely more than a bridle-path or outlet insinuated between the private fields on either side for the convenience of the good folk of Kingston Vale. At the upper end the trees thin out, forming a wide clearing dotted sparsely with furze bushes and coarse rushes.

In hard winters I have known snipe to be flushed from this spot.

Here the visitor has the choice of three paths.

Turning abruptly to the left, I took the overgrown bridle-path which runs parallel to the distant highway.

On leaving the brook the ground begins to rise gradually, and the air becomes drier and lighter. The character of the vegetation also alters considerably. Birches, hornbeams, and small oaks in a great measure prevent the sun's rays from penetrating to the ground below, and apparently the only plants which can manage to exist amidst the bracken and tangled briar bushes are the wild hyacinths.

Were this stretch in private hands it would make an ideal pheasant covert.

The mammals here are represented chiefly by the bank vole, a small creature slightly larger than a house mouse, and which might readily pass for a pigmy water-rat. The rugged ground is admirably suited to the requirements of the bank vole, which thrives and multiplies exceedingly on a generous diet of acorns, hazel nuts, and berries, to be found in plenty amidst the tangled undergrowth. A close scrutiny will reveal numerous shallow little tunnels penetrating the brown carpet of dead leaves in all directions, and if the observer has the requisite patience, he will probably experience the pleasure of seeing the voles emerge and rustle along their highway in broad daylight.

The loose sandy soil is not conducive to pleasurable walking, and, encumbered as I was with cycling and angling paraphernalia, I was glad to rest awhile on one of the wooden seats which the authorities have thought fit to provide at the top of the eminence.

Amidst the chorus of bird-music which resounded through the woodland, I was able to distinguish the notes of many of our favourite birds — the thrush, mistle-thrush, blackbird, robin, and hedge-sparrow, the nests of all of which I had previously found.

A diminutive jenny wren suddenly appeared at the top of a neighbouring bush and explosively burst into shrill song, swaying his stumpy little tail from side to side in a most amusing fashion.

Numerous tits, too busily engaged in their quest for insects to heed the observer below, flitted from tree to tree continually, uttering their soft call-notes, and on one occasion a pair of gold-crests passed in the delicate tracery of the birches overhead.

A sudden series of harsh screams, which could only be compared to the violent rending of calico, and a pair of keen-sighted jays dipped beneath the over-arching trees with a flicker of blue and white, and disappeared in the distance. This unmerited interruption had the effect of startling all the blackbirds, and, in turn, these officious birds, the "sentinels of the hedgerow," spread the alarm in all directions.

I was now anxious to work my way onwards. The summer migration of the birds was in full swing.

Ever since the beginning of April I had been visiting the Common at frequent intervals in the early hours of the morning, for the purpose of watching the newly-arrived summer migrants, which temporarily halt here in unexpected numbers on their way north.

Previous experience had taught me that I was approaching the haunts of the nightingale, and I naturally expected to hear a few of the smaller warblers, but was in no way prepared for so great a variety of interesting birds as I heard on this changeable May morning.

My visit could scarcely have been more opportune.

The morning rain had freshened everything wonderfully, and the bird voices, lulled by the storm, burst forth with renewed vigour when the sun reappeared.

Down by the cemetery, the headstones of which glistened through a hideous iron fence on the left, no fewer than four nightingales were trilling, the one against the other, and by dint of careful stalking I was able to approach within fifteen yards of one songster.

The song of the nightingale is unmistakable, but yet it is curious that the bird itself is so little known. In listening to the song we forget the songster, and the nightingale, which is a shy little bird the size of a robin, with a reddish back, and grey-white breast, becomes a nonentity when it ceases. When foraging on the ground it has a characteristic habit of suddenly raising its tail, and as gently lowering it again.

Willow wrens were to be heard in numbers chiming their descending series of sweet, plaintive notes, but the main body had passed a fortnight before, when every birch tree seemed to contain a tiny brown warbler.

Occasionally a chiff-chaff set up his jerky reiteration, and on several occasions I heard the cuckoo in the distance.

The common whitethroat I had met before. I believe the bird breeds in the less-frequented portions, but hitherto I had not made the acquaintance of his lesser relative in this neighbourhood.

The lesser whitethroat is just a trifle smaller and greyer than the foregoing, and its song, which I heard proceeding from the foliage at the top of a tall oak, consists of a monotonous trill, totally unlike that of the commoner species.

The rumble of the traffic a short distance away warned me that I was again approaching the highway. There was one more copse to be explored, a marshy little dell intersected with tiny streams drained from the high ground above, and overgrown with elders and brambles.

Within a few yards of the high-road, a nightingale was singing lustily. He had barely finished one of his thrilling passages when a grey, black-headed little bird, which had flitted silently into an elder bush hard by, suddenly burst into song.

Anybody who is conversant with the jerky notes of the whitethroat will immediately recognise the prelude of the blackcap's song.

After a few preliminary notes, the musician, whose attitude, suggestive of nervous defiance, was plainly visible, modulated his voice into a series of rich, flute-like warbles, which, if more sustained, would have been in no wise inferior to the more artificial song of the nightingale.

For so small a throat the volume of sound is astonishing. The song gives the impression of that of a blackbird and a whitethroat.

Another blackcap started in opposition, and matters were becoming interesting, when the spell was suddenly broken by the appearance of the inevitable small boy.

It was now noon-day, and the firm high-road seemed to invite the return journey. Up the hill, and down the other side, past stretches of gold-spangled furze, and civilisation was reached once more.

In spite of disappointments a most enjoyable morning had been spent.

FOUCAULT'S PENDULUM.

A PRACTICAL LABORATORY METHOD OF STUDY.

BY D. BAXANDALL, A.R.C.S.

SINCE Foucault in 1851 described his pendulum experiment for proving that the earth rotates uniformly on its axis, perhaps no problem has been more puzzling to students of physiography.

The difficulty lies in two facts—(*a*) very few students actually repeat Foucault's experiment; (*b*) even in cases where this has been done successfully, the observations are necessarily confined to one latitude.

The object of this article is to suggest a purely experimental method of investigating the behaviour of Foucault's pendulum at *any* latitude.

The one point that students do understand is that the apparent rotation of the plane of the pendulum at the pole is 360° in twenty-four hours. Less clearly, they understand that at the equator there is no apparent rotation. At any other latitude, by resolving the rotation of the earth into two component rotations about axes at right angles, it may be proved that the apparent rotation is proportional to the sine of the latitude.

To the average elementary student, however, this is not sufficiently convincing.

If a globe (Fig. 1) be taken as a model of the earth, with means for supporting a simple pendulum in

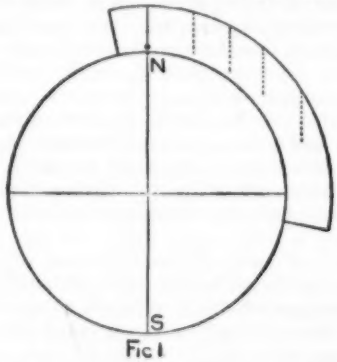


Fig. 1

various latitudes, then when an ordinary simple pendulum is placed at the north pole N., the conditions will be exactly as in nature, viz., the pendulum when at rest will point to the centre of the earth. In other latitudes (in the model) the pendulum will lie as indicated by dotted lines.

To make the conditions in the model exactly the same as in nature, the pendulum when at rest must be constrained in every latitude to point to the centre of the globe.

This may be done by making the pendulum as shown in Fig. 2. A piece of steel wire (*ab*) of uniform circular section is soldered into a solid brass piece (*ce*), which slides on the graduated arc AF, to which it may be securely clamped at any latitude. A leaden bullet serves as the bob of the pendulum, and a circular protractor or scale (*mn*) is attached to *ce* by means of a bent wire.

When such a spring pendulum is started vibrating in any particular plane it will keep to that plane unless constrained from other causes to change its direction. In one such apparatus used, the globe was eighteen

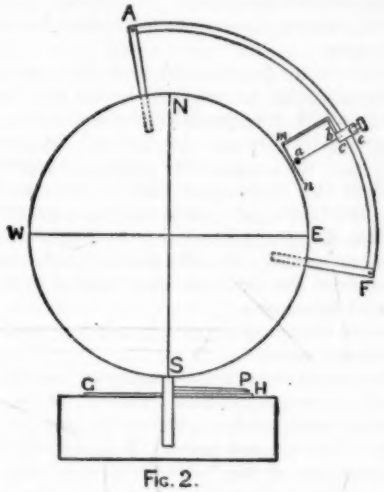


Fig. 2.

inches in diameter, and the pendulum was a steel wire five inches long and 0·05 inch in diameter. When this pendulum was started vibrating by means of the finger, the vibration would continue so that the direction of its plane could be measured for six seconds. Though at first sight this may appear to be a very short interval of time, it must be remembered that our model earth can be made to complete a revolution in, say, one second; consequently the conditions are really much more favourable than those of the actual Foucault's pendulum, which at its best will keep vibrating for only a few hours—a fraction of the time occupied by one revolution of the real earth.

Another advantage in the model is that its revolution may be stopped at any point. When this is done the pendulum will continue to vibrate in the direction which it happened to have at the moment of such stoppage.

In using this apparatus students would first satisfy themselves that at every latitude the amount of apparent rotation of the plane of the pendulum is directly proportional to the amount of rotation of the model earth.

Some fixed zero position of the model may for convenience be referred to as "noon." This is marked on the circle GH, which is graduated into degrees and hours.

Commencing with the earth at noon place the pendulum at, say, latitude 70°. Start it vibrating along the meridian, and move the earth until the pointer P is at 1 P.M. Stop earth, and read apparent rotation of plane of pendulum. Repeat this, stopping earth successively at 2, 3, 4, 5, 6, 7 P.M., etc. Plot "time" and "apparent rotation" on squared paper (Fig. 3). A straight line is obtained.

This may be repeated with the pendulum at other latitudes.

Next, each time rotating the earth say to six o'clock, read off the apparent rotation of the plane of the pendulum, when at latitudes 0°, 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°, 90°. Plot "latitude" and "apparent rotation" on squared paper (Fig. 4). A curve is obtained, showing that the apparent rotation of the plane of the pendulum is not in simple proportion to the latitude, but to some function of the latitude.

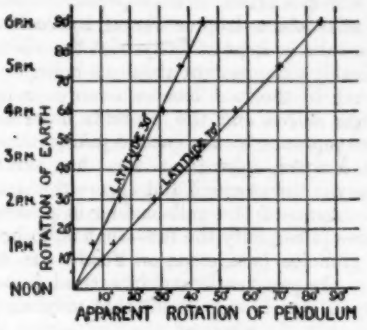


Fig.3

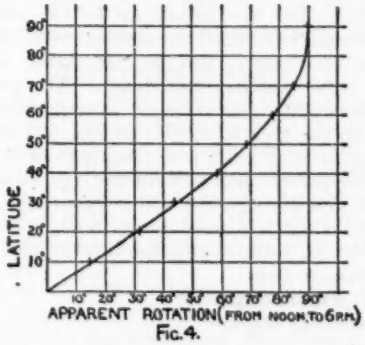


Fig.4.

Try plotting "sine latitude" and apparent rotation (Fig. 5). A straight line is obtained, proving that the apparent rotation of the plane of the pendulum is proportional to the sine of the latitude, and is in fact

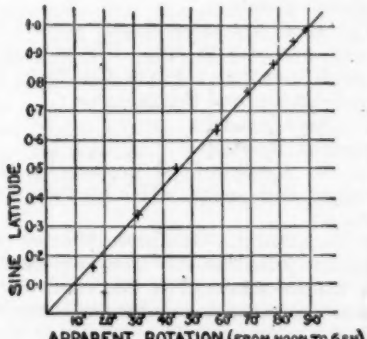


Fig.5.

equal to the actual rotation of the earth multipled by the sine of the latitude.

If such an apparatus be used in some such way as described, a better conception of the way Foucault's pendulum behaves at various latitudes will in a short time be obtained than can be arrived at in any other manner.

COURSE OF LESSONS IN DOMESTIC SCIENCE.

DIGESTION.

Step I. Preparation.—Having seen what substances are most suitable for food, we must now see what changes they must undergo before they can be absorbed by the blood and perform their tasks of building up or heating the body. As all nourishment has to be conveyed to the various parts of the body by the blood, it is quite clear that if our food is to benefit us it must be changed into a fluid form, and it is to this end that all the various steps in the process of digestion are directed.

A few words might be said, especially in girls' schools, on the preliminary preparation of food by cooking, and without going too much into the details of cookery, a few of the fundamental principles, which depend on facts which the children have already learned, might be mentioned. The object of cooking is to render the food more digestible by softening or loosening fibres, or by bursting cell walls, thus enabling the digestive juices to act on the contents. These points should be considered in deciding how any particular article should be cooked; thus, fibrous material, such as meat, etc., should be gently stewed if there is any probability of it being hard and tough, only the tenderest joints being suitable for roasting. Care should be taken, in cooking any starchy food, that it is raised to the proper temperature, otherwise, as seen in a former lesson, the cells will not be broken. In cooking meat it should first be subjected to a high temperature, in order to coagulate the albumen in the outside, thus forming a kind of crust, which serves to retain the nutritious juices during the subsequent cooking, which may be done at a lower temperature. If, however, it is desired to extract these juices, as in making broth, soup, etc., the meat should be placed in cold water and only gently heated.

Step II. Presentation: *The Alimentary Canal.*—If we trace a mouthful of food through the body, we find that it first enters the mouth, from the back of which it goes into the gullet or œsophagus, which leads it to the stomach; from thence it passes to the small intestine, and finally whatever has not been absorbed by the blood enters the large intestine. This passage, as a whole, is known as the *alimentary canal*.

The Mouth.—Here the food should be crushed and ground by the teeth, and thoroughly mixed with saliva or "spittle." There are two sets of teeth; the first or "milk teeth," which are twenty in number, only last a few years, when they fall out to make way for the permanent teeth. These divided into four classes: 8 incisors, 4 canine, 8 bicuspid, and 12 molars. The first of these are chisel-like in shape, and are used for cutting off a portion of food, which is then ground between the broad, irregular surfaces of the bicuspids and molars. A section made through a tooth shows that it is composed of a substance known as dentine; this somewhat resembles bone in structure and composition, and as it is too soft to stand the wear and tear of mastication, it is protected by a thin layer of exceedingly hard enamel. The interior of the tooth is hollow, and contains a pulp composed chiefly of nerves and blood-vessels.

The saliva, or moisture of the mouth, is produced by three pairs of glands, one situated just in front of each ear, and the others in the lower jaw.

The Gullet, or Œsophagus, is a tube about 8 inches in length, which leads from the mouth to the stomach. It is situated just behind the windpipe; therefore, to prevent the food entering the wrong channel, the latter is provided with a kind of lid—the epiglottis—which closes during the act of swallowing.

The Stomach is a dilation of the alimentary canal forming a muscular bag having a capacity of about 150 cubic inches—that is to say, it will hold about two quarts of water. A piece of tripe, which is the inner coat of the stomach of the bullock, should be shown, in order that the children may be acquainted with its structure. When examined under the microscope, the inner lining of the stomach is found to be covered with tiny openings, each of which is the mouth of a small tube or gland, which secretes a fluid known as gastric juice. This is a colourless liquid, composed chiefly of water, hydrochloric acid, and *pepsin*.

After leaving the stomach the food enters the *Small Intestine*, a tube about 20 feet in length, the inner surface of which is crinkled or folded. This folding serves two purposes—(1) it prevents the food passing too rapidly through the intestine; (2) it gives additional surface to the inner wall, thus enabling it to carry on the process of absorption to a greater extent. The most interesting point in the structure of the wall of the intestine is the presence of a large number of minute thread-like processes; these are placed so close together that they resemble the pile of velvet, hence the lining is known as the *villus* or *velvet coat*, and the processes as *villi*. At the first turn of the small intestine, just as it leaves the stomach, are to be found the mouths of two small tubes or ducts, one leading from the gall-bladder and the other from the pancreas. The former conducts the bile, which is secreted by the liver and stored up in the gall-bladder, while the latter brings the pancreatic juice.

The *Large Intestine* forms the last part of the alimentary canal; this is furnished with glands similar to the small intestine, but most of the work of digestion is finished by this time, and little besides the insoluble and indigestible matter reaches the large intestine.

Step III. Association.—Now let us see the changes that take place in our food as it passes through the various parts of the alimentary canal.

We will suppose that the food is placed upon our plate properly cooked; the first step is to take a portion in the mouth and pound it as small as possible with the teeth, in order that it may be more easily acted upon by the digestive juices; at the same time it should be thoroughly mixed with saliva, especially if it is of a starchy nature, since the saliva is able to convert starch into grape sugar, which is the only form in which it can be assimilated. This action of the saliva can be shown experimentally by mixing a little with a weak solution of starch in a test tube, and keeping the mixture at about the temperature of the body, viz. 90° F. After about half-an-hour the mixture should be divided into two parts, the first being tested for starch with solution of iodine, and the second for glucose with Fehling's solution. The absence of any blue colour in the first will show that the starch has disappeared, while the red precipitate in the second will show that it has been converted into glucose.

After being pounded by the teeth and acted upon by the saliva the food next passes into the stomach. Here it is churned about by the contraction of the walls of the stomach, so that the whole of it may be thoroughly mixed with the gastric juice, which acts upon the proteids, converting them into liquids known as peptones. This may be shown by finely mincing some hard-boiled egg and placing it in a test-tube with water, to which has been added a pinch of solid pepsin (obtainable at any chemist's) and a drop or two of hydrochloric acid. If the test-tube is kept at body-heat the white of egg will completely disappear in about an hour.

The starch in the food has been more or less acted upon by the saliva, and the proteids have been converted into peptones by the gastric juice, but so far the fats have escaped, now their turn has arrived. As the food leaves the stomach and enters the small intestine the contents of the gall-bladder is poured into it, which serves to emulsify the fat—that is, to break it up into tiny globules (see lesson on Food). In this it is assisted by the pancreatic and intestinal juices, which also act upon starch or proteids that may so far have escaped, so that the whole of the food except the hard, insoluble portions is now reduced to a state in which it is able to enter the blood.

How the Food enters the Blood.—When the food has been acted upon in the way we have described, the peptones, sugars, and converted starches pass the thin walls of the blood-vessels directly into the blood, but the emulsified fats are sucked up by the villi in the intestines, and conducted to another set of vessels, known as lymphatics, and do not enter the blood until the latter reaches the heart. The process by which liquids can pass through a membrane can be shown by tying a pig's bladder to the end of a glass tube, filling it with milk, and placing it in a vessel of water. The liquids will now diffuse, the milk passing out of the bladder and the water passing in, but the latter will be seen to take place much more rapidly than the former, thus causing the level of the liquid in the glass tube to rise.

Step IV. Formulation.

The alimentary canal—

(*a*) The mouth with 32 teeth (8 incisors, 4 canine, 8 bicuspids, and 12 molars), and 3 pairs of salivary glands.
(*b*) The gullet.
(*c*) The stomach, the inner coat covered with gastric glands.
(*d*) The small intestine—inner surface wrinkled and covered with villi. The entrance to the small intestine receives the ducts from the gall-bladder and the pancreas.
(*e*) The large intestine.

The process of digestion—

(*a*) *In the Mouth.*—Food ground by teeth and mixed with saliva, which converts starch into sugar.
(*b*) *In the Stomach.*—The proteids acted on by the gastric juice and converted into peptones.
(*c*) *In the Intestines.*—The bile emulsifies the fat, and the pancreatic juice completes the work of the saliva.

The food is now in a condition in which it can pass through the thin membrane which forms the walls of the blood-vessels and lacteals.

Step V. Application.—The knowledge the children have gained of the digestive organs and the process of digestion should enable them to avoid indigestion and other gastric troubles. Indigestion is due to the break-down of some part of the digestive system, generally

due to undue strain thrown upon it, and which might have been easily avoided. The chief causes are—

1. Insufficient mastication, owing to eating too rapidly or to imperfect teeth. The care of the teeth is of vital importance; unless they are frequently cleaned, the food which collects in the crevices will decompose and act on the enamel. The teeth must be cleaned at least once a day, and the mouth washed out with solution of carbonate of soda to neutralise the acids which have been formed.

2. Imperfect insalivation, owing to the food being swallowed too soon, or to the practice of drinking while eating, which stops the action of the salivary glands.

3. Undue strain thrown upon the stomach by eating too much, by taking unwholesome or unsuitable food, or by taking meals at irregular intervals.

4. Derangement of the liver, generally owing to insufficient bodily exercise.

NOTES ON AN EXPERIMENTAL COURSE OF LESSONS ON PLANT LIFE AND SOIL.

BY EDWARD J. RUSSELL, D.SC. (LOND.),

Lecturer in Chemistry, South-Eastern Agricultural College, Wye.

The Feeding of Plants.

Experiment 44.—Set a number of beans germinating, then divide into three equal lots. Leave one lot of the young plants in a basin without any water. They live for some time, and develop long stalks but small leaves. Rather extraordinary results are sometimes obtained, but the growth is quite abnormal, and it is evident that some essential requirement has not been fulfilled.

Experiment 45.—Place the second lot in a basin, and supply at intervals pure water. This should be previously distilled by the method of Experiment 114 (Air and Water, Sept. 1905, p. 135), so as entirely to remove solid matter. If, however, clean rain water is available, or if the ordinary supply is known to be pure and soft, distillation is unnecessary. Growth is now better than before, but still abnormal.

Experiment 46.—Put the remainder of the young plants into glazed pots (*e.g.* jam-pots) containing some ordinary garden soil. One is to be left without water, another is kept flooded with water so that the surface of the soil is always covered, a third is simply kept moist by occasional additions of water. Growth in the first two pots either ceases or becomes very abnormal, in the third a healthy plant is obtained.

These experiments teach us that the plant requires

soil, water, air.

The latter requirement must be arrived at by a process of exclusion. We have always found (Experiment 30, Air and Water) that soil contains a large volume of air, which would naturally be driven out by a large excess of water.

Importance of the Soil.

Experiment 47.—A useful box, enabling one to watch the development of the roots, may be constructed by fixing on to a piece of wood two uprights, each 6 inches high and 1 inch wide, fitted with grooves. The uprights should be about 1 foot apart, and should be as nearly as possible parallel to each other. Obtain two pieces of glass to fit these grooves, putty them in, and you now have a glass case with front and back 12 inches by 6 inches, and about 1 inch depth. Fill with soil, and sow various seeds. Root development can be traced without much difficulty.

Experiment 48.—The importance of the root in the nutrition of plants is easily established by cutting off a bean plant level with the soil, and planting the upper part in another pot. Water may be supplied whenever necessary, but the plant will not usually survive. Some plants will, however, after a time begin to make growth; examination will show that in this case they have made fresh roots.

All soils are not equally useful in supplying plant-food.

Experiment 49.—Take two pots, fill one with sand and another with good soil, put plants in each, and keep properly watered. Notice that better growth takes place in good soil than in sand.

In general the above treatment will probably be sufficient, but where the teacher wishes to introduce manurial experiments in the school garden, and for night-school purposes, it is desirable to pursue the subject somewhat further.

Experiment 50.—Take seven large bottles holding from 2 to 3 litres, with corks to fit. Paint the tops of the bottles with Brunswick black, and make cylinders of cardboard or black paper to surround the part below the blackening. Bore two holes in each cork, and put a glass tube through one to lead down to the bottom of the bottle, leaving the other for the seedling. Take a sheet of blotting-paper about 8 inches by 12 inches, place a row of seeds of cabbage, buckwheat, or barley about 2 inches from the shorter side, and roll up the paper fairly tightly, so that the seeds are held between the folds of the paper. Place the roll in a jar with a little water at the bottom, and cover the top with a glass plate. In a few days the seeds will germinate, and the roots will grow downwards in the moist atmosphere. When the roots are 3 or 4 inches long unroll the paper, and select the best.

Fill each bottle with *distilled* water (rain water or pure tap water will not usually do instead), to half an inch of the top.

Put the seedlings carefully through the hole without damaging root or shoot, wedge them in position with a tuft of cotton wool, taking care that only the roots dip in the water. Let them stand in a bright light, but protect for a few days from direct sunlight.

Prepare solutions as follows:

(1) A saturated solution of calcium sulphate.
(2) A 5 per cent. solution of sodium nitrate.
(3) A 5 per cent. solution of potassium chloride.
(4) A 5 per cent. solution of acid sodium phosphate.
(5) A 0·5 per cent. solution of ferric chloride.

After the roots of the seedlings have begun to grow in the water, add the nutrient solutions from a graduated pipette, using for each 100 c.c. the jars hold:—

A, nothing.

B, 10 c.c. of (1), 2 c.c. of each of the others. This is to be labelled "Complete plant food."

C as B, but omit (1). Label "No calcium."

D as B, but omit (2). Label "No nitrogen."

E as B, but omit (3). Label "No potassium."

F as B, but omit (4). Label "No phosphate."

G as B, but omit (5). Label "No iron."

Stir up well and replace the corks with the seedlings. As growth proceeds replace the water evaporated by distilled water. Aerate from time to time by blowing

with bellows down the tube. If the solutions become turbid renew them.

A few words must be added about the object of the various steps. The particular method of germination used here is recommended in order that a long, narrow bundle of roots may form, whereby the difficulty of getting the plant through the cork and into the bottle is much reduced.

The bottles are blackened partly because roots prefer darkness, and partly to inhibit the growth of certain algæ which would flourish in the above solutions.

Oxygen being essential for the roots, it is necessary that the liquid should be kept saturated with air.

Turbidity in the liquid would arise from extensive development of bacteria.

Usually the experiment is very successful once the initial difficulties are overcome. A shows little growth; B produces quite a normal plant; C is stunted; D very much so—it also acquires an unhealthy reddish tinge; E goes on well for some time, but, if it ever reaches the flowering and seeding stage, it becomes abnormal; F develops badly, and in particular shows very little production of root; and G should produce little chlorophyll, becoming almost white. G sometimes breaks down, however; a certain amount of iron may be contained as impurity in the chemicals or the water, or may be extracted from the glass.

The above are spoken of as water cultures. Sand cultures are often used instead. In this case the plants are grown in glazed pots full of sand which has been carefully washed both by dilute hydrochloric acid and by water to remove all soluble matter. To each pot is added the appropriate solutions as in the above water cultures; the plant grows under more normal conditions, and there is a greater probability that the experiment will succeed. But the preliminary washing of the sand is so troublesome that in a school the water culture method is preferable.

Where manurial trials are being carried out in the school gardens, the above solutions could be made from the particular manures being used. Thus, (3) could be made up from potassium sulphate or kainit, (4) could be a solution of superphosphate, but as this contains calcium sulphate, (1) and C would become superfluous, and F would be "No phosphate and no calcium."

The aqueous extract from a fertile soil will often give complete development, and may be used to compare with B.

Science Courses for Teachers.—We have received from the Board of Education, South Kensington, particulars of the conditions under which science teachers will be admitted free for a term or for a session to the Sessional Courses of instruction in the Royal College of Science, South Kensington, as students in training. In making selections preference will be given to applicants who are, or have been already engaged in teaching science. No applicant under eighteen or over thirty-five years of age, unless under exceptional circumstances, can be admitted.

The courses given and the duration of each are as follows:—*Chemistry*—Part I., October to February; Parts II. and III., October to June. *Physics*—Part I., February to June; Parts II. and III., October to June. *Mechanics*—Part I., October to February; Parts II. and III., October to June. *Biology*—Part I., October to February; Parts II. and III. (Zoology), October to June; (Botany), October to June. *Geology*—Part I., February to June; Parts II. and III., October to June.

Applicants for Studentships-in-Training are required to fill up and forward Form 400 before the 15th June, and Form 1019 before the 20th June. Copies of these forms may be obtained from the Secretary, Board of Education, South Kensington, London, S.W.

COMMON-SENSE NEEDLEWORK.

BY MISS FLEMING,

Authoress of "How to Teach Needlework," "Pupil-Teachers' Needlework," "Sewing-class Guides," etc.

FIRST LESSON IN HEMMING.

HEM is a Saxon word meaning "to enclose," and we use it in its oldest sense when we say of an army that it is hemmed in on every side. In needlework, it is a method of fastening or enclosing a raw edge, to prevent it ravelling. It is the initial and simplest kind of sewing, and therefore suited to beginners. When efficiency is secured in hemming, all other stitches will be found comparatively easy of performance, and as knowledge increases, so will a liking for plain work increase.

The mechanical effort is not drudgery when the needle slips in and out easily, while the rhythm of needlework is soothing to the nerves. Children feel the nausea of long seams, only when the labour is excessive, owing to wrong method or lack of skill, which also produce sticky needles and dirty work. When they have grown accustomed to watching the easy, graceful motion of the teacher's hands, the pleasure it affords their eyes, induces efforts to imitate it, and when once the skill is acquired, joy in the action follows.

Needles.—These should be of good quality. If the steel be good it will snap and not bend. A crooked needle should not be used. "Betweens" are more suited to little fingers than long needles. They should be a little thicker than the thread used, that the eye may make a hole large enough for the cotton to run through easily. Both needles and button should be suited to the material to be sewn.

For ordinary school calico, No. 7 or 8 needles will be found convenient. An emery cushion is useful to clean rusty, sticky needles. They may be made to run more smoothly by rubbing them in the hair.

Thimbles.—These must fit the finger for which they are intended. A little thimble perched on the tip end of a big finger, or a big thimble stuffed with paper on a little finger, is equally unsuited for beginners. The young workers will find quite enough difficulty at first in using the implement properly, without being incommoded by an ill-fitting one. No child should be allowed to commence sewing until she has her thimble on her finger.

Scissors.—There should be at least one pair of small scissors between every two girls in the upper classes, as they will be required for cutting off ends, etc.; otherwise the teeth will be brought into requisition, which is a very harmful habit; or the thread will be broken off and the work rendered insecure. If the needle be threaded before the cotton is cut off the reel, it will be done more quickly, as that end of the cotton slips through the eye more easily than the other end.

Position for Sewing.—This should be free and easy. The hands should be held away from the chest, and the head only slightly bent.

Our grandmothers used to fasten their work to the knee, which encouraged a cramped, stooping, ungraceful position.

In Norway a strap is fixed to the desk to which the child may fasten her work.

An experienced needlewoman may sometimes attach her work to something fixed when making a long strip in running stitch, but in ordinary school work that is quite unnecessary.

Specimens.—Prepared, fixed specimens, *several inches long*, should be in readiness in sufficient numbers to allow for, at least, one between two girls. The strips should contain such stitches as are large, clear, and well-spaced, capable of being copied exactly. As progress is made the stitches will become slightly smaller until an everyday commonsense style is produced. If the methods described are followed regular, even sewing will be the result without any undue eye strain.

The class will now be asked to look critically at the specimens provided, both at the back and at the front, and the following points must be elicited :—

(1) The side with the fold is the wrong side, and will face the sewer when working.
(2) The stitches on the back or right side are all the same size, shape, and the same distance apart as those on the front or wrong side. No sewing will be considered good that does not answer to that description.

When the stitch is correctly made it is in the shape of a right angle ⟋⟍, half being on the right side and half on the wrong side—the continuous line representing the side on which the hemming is worked, and the dotted one the under or right side.

The Work-holding Drill should be revised at this point, and the teacher must satisfy herself that the work is placed straight round the end of the finger, and not sloping at all.

Fastening the Cotton.—The teacher will take up her own strip of hemming to show how the needle is pointed backwards and upwards and drawn through, leaving a small piece of cotton below the hem. The class must watch her place her left thumb on this to hold it fast, until it is made secure by two or three stitches. These stitches having been made, the cotton may be tucked under the fold and lost to sight.

Joining New Threads.—This is performed in the same manner as fastening the cotton after half a stitch has been undone, and the old cotton left out to be tucked under with the new, when a few stitches have been made.

Hemming.—This is not so easy for the little ones as it appears to older people. It is also more difficult to work near the end of the hem than further on, so much patience will be needed. It is better to spend longer over teaching a fresh step than to have to unlearn wrong methods later.

Discipline plays an important part in the simultaneous needlework lesson, and the teacher will do well to see that every eye follows her movements. She will proceed slowly, using some such formula as follows, suiting the action to the word :—

(1) Place the work over the finger.
(2) Put the needle to the thimble.
(3) Place the cotton between second and third finger of the right hand.
(4) Point the needle to the middle of the left thumb-nail.
(5) *Push* the needle through with the thimble.
(6) Draw out the needle, letting cotton fall between the fingers as it comes away.

The teacher will have to repeat this many times, at first using the formula, and afterwards letting the children use the formula, as she goes through the movements.

Then she will sew without the formula, that the class may see how the motion is kept up with a regular swing.

N.B. This continuous motion or regular "swing" is all important. Until the worker can keep her needle moving in and out with rhythm and precision *she cannot sew properly.*

After watching the movement sufficiently to see its grace and freedom, the girls may be allowed to attempt a little themselves.

At first they will do it stage by stage, the teacher using the formula, and closely watching the class to see that the instructions are rigidly carried out. As soon as they have learnt the various steps they may be allowed to go on working for a while.

The teacher must stand in front of the class all the time, noticing those who have grasped the instructions and those who have not, but otherwise not interrupting them for a few minutes, as their attention will be needed to master the details. When time enough has been given them to make a fair attempt, the class may be stopped, that the teacher may go through the instructions again slowly, using the formula if necessary.

The class may now make another attempt. This time the teacher will notice the mistakes of individuals, which she will be able to detect easily from her point of vantage.

Class Faults in Method.—She will single out some with the most pronounced faults. For example, some girls will have been pulling and tugging at the needle. That is because they have not *pushed* it far enough into the work with the thimble. Wherever there is any dragging or pulling at the needle, the thimble has not done its duty perfectly, which is to force the eye quite into the material. The teacher must again pattern the continued motion, emphasising particularly the thimble pushing the needle quite through. The class will try again, and other faults of method will be discovered.

This time, no doubt, some of the girls will have clasped the cotton in the hand, instead of allowing it to pass out between the second and third fingers.

Stop the class. Show how to place the cotton in position before starting, and how the thimble-finger is slightly raised to allow the cotton to slip into place as the needle is being drawn out.

After every break the teacher will show how the "swing" is kept up, before the class returns to work and the teacher resumes her critical attitude.

This time she may notice that some children have pushed the needle partly in, and then taken the hand away, putting it back again to complete the drawing out.

Teacher will show how the hand never leaves the work without bringing the needle with it.

At the end of the lesson it will be found that the girls have made a distinct effort to follow the directions, but it will be well for the teacher not to criticise the sewing.

Each girl, however, should examine both sides of her own work, and also that of the specimen in front of her, that she may see for herself how far she has imitated her copy.

This manner of teaching must continue until the teacher can see that each girl is able to keep up the "swing," and that she is following the correct method.

Then it will be soon enough for the teacher to look

at the individual work to see what kind of stitches have been made, but it must not be forgotten that at the beginning correct method of working is more vital than good work. The latter *will* come if the teacher has been efficient.

If the teacher studies the strips of hemming *after they are collected*, she will be able to detect class weaknesses and find the remedy.

Faults in Hemming.

Poor hemming is caused :—

(1) By pointing the needle too vertically in the work, thus making an upright stitch.
(2) By putting the needle in immediately below the place where the cotton comes out, thus also making an upright stitch.
(3) By putting the needle too far in front of the cotton, thus making the stitch too long in front.
(4) By taking too much on the needle, thus making the stitch too big at the back.
(5) By not taking the needle right through the material at the back, thus making a "split" stitch.

All produce deviations from the orthodox regularity, which should show a continued series of right angles, the under half of the stitch being on the right side of the work, and the upper half on the wrong side—the slope of the stitches and the distances between them being always the same

Dirty work is caused by using too long needlefuls of cotton, and by drawing out the cotton in the closed hand, instead of letting it come out between the second and third fingers of the right hand.

Repairing by Hemming.

It is most imperative that children realise that the strips done at school are only a means of teaching them how to sew garments, etc., at home. Accordingly, after some degree of perfection has been attained in hemming, *i.e.* when the stitch is formed correctly and the movement can be kept up, the class should be required to bring *clean* articles from home that require hemming.

Tablecloths, serviettes, handkerchiefs, aprons, etc., whose hems are beginning to give way, or crack, will serve a useful purpose. Dusters and dustcovers, sheets, pillowcases may be hemmed. Skirts, drawers, pinafores that need the bottom cutting off and re-hemming, or any new garment that mother is making, may be requisitioned—the only stipulation being that it requires hemming and is clean.

The class being provided with some article to be hemmed, the teacher will talk about hems—what they are for, where placed, how fixed, etc.

She will illustrate by showing the frayed edges, and cutting the fringes off—which would make the hem clumsy if turned in.

She will exhibit something with an uneven side, and show how to cut it straight.

She will also exhibit table and bed linen with broken or cracked hems, and show how the article will be made worse in washing and wearing, and point out how much longer it would last if mended.

Having a straight side to fix, she will show how, by turning a little down with both thumbs, holding it tightly, and stroking with the left middle finger nail, a hem may be easily folded. She will also insist upon the work being pressed between the thumb and finger.

The Work must be Tacked.—Emphasis of that point is necessary, as girls are very fond of omitting the tacking, with dire consequence.

The tacking must be done a little above the edge of the fold, to fasten the turn underneath.

The knowledge that they are really doing something useful, and the consciousness of growing power, will be stimulating, and the girls will work with great zest.

For sewing curved seams or hems, the material may want stretching or easing according to the shape, but such work is too difficult for very young children.

"SUGGESTIONS" ON TEACHING HISTORY.

BY HENRY SMART, M.A.

(*Continued from p.* 461.)

WE now pass on to the important question of the comparative virtues of books and lessons. *The Book of Suggestions* wisely says that the use of a book may begin at the age of nine, but should be chiefly confined to the last three years of school life; while even then "oral teaching is still indispensable, and should be regarded as of the first importance." The use of a text-book gives definiteness to the work, and leads to that power of private study which must be acquired at school. "History offers exceptional opportunities for the training of children in the power of silent reading with intelligence and concentration." The danger is that learning will be by rote; this, we are reminded, may be partly prevented by reading different accounts of the same event.

All teachers agree that a book must be used. "Text-books, except in teaching very small boys, are indispensable. The necessary facts—the grammar—of history must be learnt by reading and not by hearing; it is the business of the book to narrate, of the teacher to illustrate, explain, supplement."[1] Care is of course needed in the selection of a text-book. We must consider type, style, matter, and illustrations and other supplementary matter. During the last few years many text-books have been issued, adapted to the needs of boys of all ages, and it is not now difficult to choose a good one. It is easy enough to find fault, particularly with regard to the question of proportion. But when we have finished criticising—better still, before we begin to criticise—we should remember that the chances are that the author has spent more time in considering the matter than we have. Mr. Browning's ideal text-book is "a simple, straightforward narrative, full of facts, and without any pretence to style, carefully divided into paragraphs, and well furnished with dates, genealogical tables, and other *adminicula*." But he would like boys to have three books—a skeleton, a text-book, and a hand-book.

In choosing a text-book, the teacher must read it with the children's mind and their knowledge. Frequently a book is pleasing to him, while to them it is quite unintelligible without an altogether disproportionate amount of explanation. This sometimes arises

[1] *The Teaching of History*, p. 81.

because the author, forgetting the attainments of his young readers, indulges in hints and allusions, a fault bad enough in one who writes for adults, but quite unpardonable in a children's book. A book is also unsuitable if it indulges too freely in questions of cause and effect, and in wide generalisations. The text-book is to give facts, not theories. Without facts, theories and generalisations are worthless. With regard to the style, it must be remembered that in the upper classes this should not be too simple.

We shall soon see from their answers, whether oral or written, if the children are learning by rote. If there is a fear of this, a few questions will soon reveal the fact and show its absurdity. For this reason, if for no other, the teacher must know thoroughly the book used in the class.

While wide reading is to be discouraged, children should use more than one book. Many people have a laudable ambition to know "everything about something and something about everything." In the same way boys should know everything about one book and something about several others. The teacher, while encouraging them to find books for themselves, should guide them in their choice. For example, when studying the history of Henry IV., he should tell them to read *The Fair Maid of Perth;* or, when learning the Wars of the Roses, Oman's *Warwick;* or, when studying early English history, they will enjoy York Powell's *Early England*, or even Church's *Early Britain*. To show them the pleasure they may derive from reading, he should read selected passages to them. This is the advice given by Sir Joshua Fitch, and is the advice given in the *Suggestions*. The account of the Fire of London given by Pepys, and Macaulay's account of the Siege of Londonderry, are as good examples of this kind of thing as we can find.

One argument brought against the use of a text-book and the practice of private study, is that so large a part of the time thus spent is wasted. The amount has been put down at three-quarters of the whole. But if this is true, it is rather an argument in favour of the practice than against it. We say once more, this power of private study must be acquired at school, or school time is largely wasted. The fact, then, that the habit is difficult to acquire, is a very good reason for giving training in this direction. Moreover, when it is said that three-quarters of the time is wasted, what is meant is that it is wasted as far as learning history is concerned. But if power is being acquired, the time is not wasted. Here, as in everything else, it is a question of growth. At first we set a paragraph to be read, and then question on it. From that we advance to pages, chapters, books. This is the view taken by those in authority over us. "It is advisable to let the pupils prepare particular topics from the book by study in school, or at home, and to test their knowledge of the subject afterwards," this testing to be done orally or in writing. At first there will be an inability to distinguish between the important and the trivial, but gradually the power will be acquired of picking out the salient points and attaching the rest to these. Thus will gradually be acquired the important art of using books, until at last we are able to "change the dull routine of historical study into a voyage of pleasurable discovery."[1]

But though books must be used, yet lessons come first both in order of time and in importance. If teachers neglect these it is not for want of warning. We quote the one in the Blue-Book. Even in the upper classes "oral teaching is still indispensable, and should be regarded as of the first importance," and "no book, however good, can, with children of this age, supply the place of vivid and vigorous personal teaching." Further on, we are reminded that for successful teaching "a course of well-prepared oral lessons, the preparation of which will mean the expenditure of time and thought on the part of the teacher, will be necessary." With all this we heartily agree. Neither with regard to matter, treatment, nor phraseology, should the teacher trust to the inspiration of the moment. He cannot select his facts as he stands before his class; if he tries, he will probably give an ill-proportioned lesson. If he settles the method of treatment as he goes on, he will frequently have to break off to bring in some points which have been overlooked; while, with regard to phraseology, it is sufficient to point out that the teacher's language largely forms the scholar's style. A severe warning is given in a footnote on page 120. "The reading aloud of a history book by the scholars, with occasional explanations by the teacher, is not a proper method of teaching history to children."

In the junior classes oral lessons are the only means employed of teaching history. In the upper standards they are still important, but here they also give the opportunity to arrange, combine, and explain the facts given in the text-book, a very necessary work in order that what is learnt may be appreciated. The lessons must be suited to the class, and in this respect the choice of language is very important. With very young children it should be very simple, but with older children it should not be too simple; boys of fourteen are not to be taught in language suited to the capacity of children of nine. There must also be a change in the character of the lessons. With young children it is necessary to question frequently as we go along, in order to ensure attention and comprehension; but even here we must not have too much of this, or the lesson will be disjointed. Questions must not be allowed to spoil the flow of the narrative. "The extremes to be avoided are fact-cramming on the one hand and flowing talk on the other."[1] The subject of the lesson will largely decide the style. An easy and interesting subject may be treated with fewer breaks or questions than one which is hard and somewhat dry. In the upper classes lessons may partake more of the nature of a lecture. We know that in some quarters this idea is thought to be almost heretical, but we regard it as part of a boy's education that he should learn to listen to and to absorb a lecture.

Boys should also learn to take notes of the lessons. This is a special point which needs considerable attention. The way not to do it is for the teacher to write notes on the blackboard and for the children to copy these into their books. This is a common, but almost useless, practice. Let the teacher by all means write notes on the board now and then, particularly at first, to show how it should be done; but copying these is not a very useful exercise. When the notes have been taken they must be collected and corrected. Then if the teacher goes through them with the class, pointing out errors in matter and arrangement, this useful power will in time be acquired. Mr. Oscar Browning once

[1] *History in Schools*, p. 97.

[1] Hinsdale, p. 59.

suggested a plan which has been found to work well with upper classes. Usually there are two lessons each week. Let the first of these be devoted to the lesson, or lecture, the teacher having carefully prepared what he is to say, and speaking slowly. While he speaks the boys take as full notes as possible. These notes are then entered in an exercise-book, a task which may well serve for home-work. Before the next lesson comes round the teacher must have examined these note-books. He then spends a large part of the second lesson in clearing up difficulties of whose existence he has learnt from his examination of he books, in illustrating and questioning on his last lesson. During the rest of the lesson, says Mr. Browning, the teacher may introduce some subject "of a more or less speculative character" to serve as a subject for an essay; but this part of the plan could not be used very much in elementary schools. Experience will show that this method of teaching is successful, but of course it is practicable only with small classes of well-advanced boys. One great advantage of it is that the teacher is constantly seeing whether he has been understood. When the plan is followed it is to be noticed that the pupils do not take short notes of the lesson, but a full report of it.

This question of notes leads to the general question of written work, concerning which not much is said in the *Suggestions*, though it is mentioned as being suitable during the last three years of school life, and it is stated that "subjects for composition should be frequently taken from the history lessons in the case of older scholars" (p. 63). Written answers may be required from all scholars but the youngest. They must, of course, be graduated in difficulty. Young children should be given questions requiring answers of three or four lines, while the eldest may well write answers which are practically essays. The life of some eminent person is a fit subject for an essay, and if independent reading be encouraged such an exercise will at first produce some most delightfully trivial matter. In addition to bare narration of facts, questions as to causes and effects should be answered by elder scholars. Comparisons and generalisations may also be attempted, but only in moderation, as the store of facts at the pupils' disposal is not large enough to warrant much of such work. Such comparisons as between the conquest of England by English, Danes, and Normans, between Edward the Confessor and Henry VI., or between the results of Roman rule in England and British rule in India, are simple, and may be attempted.

This written work needs careful correcting. Boys have a wonderful facility in using the words of the book, and a wonderful courage in using words they do not understand. The teacher must therefore know the book. He must also make sure that words are being used to show knowledge and not to hide ignorance. How often, we wonder, have boys, in describing Wat Tyler's insurrection, used the expression "bound to the soil," a phrase which to an open mind recalls *Gulliver's Travels*? And with what temerity do boys use such words as "constitutional," "charter," or "fief"! The teacher must question boys on their own answers.

A special branch of questions consists of problems. Seeley says, "to form any opinion or estimate of a great national policy is impossible so long as you refuse even to imagine any other policy pursued."[1] If we remember the difference between Seeley's students and our pupils we may take this opinion to heart, in spite of the horror of such exercises expressed by Mr. Augustine Birrell. Such questions are very suitable for essays. They demand knowledge of facts, appreciation of them, and some imagination. For instance, boys can write on the results that would have followed had Harold won the Battle of Hastings, or if Warwick had not been killed at Barnet. They can discuss the question as to how history would have been changed had the marriage between the Maid of Norway and young Edward been accomplished; or had the series of mishaps, which delayed Richard II.'s return from Ireland, and resulted in the dispersing of his troops before his arrival, not taken place. These and similar questions might be discussed by a university lecturer, but they may also be treated by boys in the upper standards of an elementary school; the fact that they are suitable for the former does not make them unfit for the latter.

Attention is drawn in the *Suggestions* to a special part of the study of history—that of biographies. Its importance is stated on p. 61. "History is to a certain extent a record of the influence for good or for evil exercised by great personalities." Not only is this study important, it is also interesting, and fortunately there is abundance of material from which to choose—a combination that does not often occur.

Biographies are especially interesting to the young. During the first three years history is learnt wholly in this way. There is a human interest in biographies which appeals to the young. An individual appeals to them far more than does a nation, and abstract ideas do not appeal to them at all. From this study boys obtain reasonably clear ideas on subjects otherwise unintelligible to them. "In reality *ideas* are unsuited for teaching purposes in case of the very young. 'The King' is abstract. William I. is concrete. The first will fail as an exercise of the imagination, the other will succeed,"[1] and with the very young the exercise of the imagination is one of the chief ends of historical study.

But it is not only the very young who delight in biographies. Mr. Augustine Birrell has expressed the pleasure he feels in sometimes "turning off the turnpike of history to loiter down the primrose path of men's memoirs of themselves and their times." So our scholars will be glad if we, following the advice of various authorities, turn off the beaten track of our lessons to spend one on some striking person, such as the King-maker, or Robert Clive. The object and treatment will, however, be different in the two cases. With the younger pupils we shall arouse interest, excite the imagination, and point out such virtues as persistence and ultimate triumph over difficulties, as, *e.g.* in the case of Columbus. With older scholars we shall show how the ground was prepared, estimate results, and show causes of success or failure.

The drawback to this study lies in the matter of details. If we are to give a continuous narrative, and a reasonably complete picture, we shall probably have to introduce matter which is of little consequence.

Scattered throughout the *Suggestions* one finds a number of hints. With these we now propose to deal. Some of them are excellent, but a few we hope are unnecessary.

1. History in the past has dealt too much with wars

[1] *Expansion of England*, p. 163.

[1] *The Teaching of History*, p. 73.

and battles, and the doings of great kings and nobles, and too little with the life of the people; attention should be given to the "triumphs of peace as well as those of war." This, of course, is perfectly true; it is largely a plea for the teaching of Social History, a branch which is apt to be overlooked altogether, or relegated to a brief paragraph or two. But the warning ought now to be hardly necessary. Carlyle uttered it in his grand manner seventy years ago. Speaking of the historian he said, "From of old, it was too often to be reproachfully observed of him that he dwelt with disproportionate fondness in Senate-houses, in Battle-fields, nay, even in Kings' Antechambers; forgetting that, far away from such scenes, the mighty tide of Thought and Action was still rolling on its wondrous course, in gloom and brightness; and in its thousand remote valleys, a whole world of Existence, with or without a heavenly sun of Holiness to purify, sanctify it, with or without an earthly sun of Happiness to warm it, was blossoming and fading, whether the 'famous victory' were won or lost." And J. R. Green, who spoke to a larger audience, taught the same. At the same time, while it is perfectly true with regard to the older boys, it is to be remembered that the striking personalities who provide study for the young are not often to be found among the ordinary people, as will be seen by studying the lists suggested in the Blue Book itself.

2. Do justice to other nations. Surely here again we have an unnecessary warning. Surely no teacher in studying, *e.g.* the wars of Scotland for independence, the Hundred Years' War, or the War of American Independence, would fail to do justice to our opponents.

3. Our pupils are young. Much must therefore be passed over for the sake of proportion. We can deal only with "great deeds of great actors," for, as the next paragraph says, events are to be clear and intelligible, and impressions permanent. This is very wise, for the teacher, in his desire to give a connected story, is apt to drag in too many details. Details in moderation help the memory, in excess they overburden it. At the same time the "great actors," by speaking of whom we obtain that human and personal interest so necessary for children, are, as we said above, not typical of "the life of the people as a whole."

4. Pictures, maps, and plans are all useful, but "adults are prone to think that a picture makes more impression upon a young child's mind than it actually does." This is perfectly true, and it is largely because the child looks at the picture with little or no knowledge, as well as with an untrained eye. What was said with regard to text-books is equally true here. In estimating the effect of a picture upon the child's mind, the teacher must try to look at it with the child's knowledge. If not, he will unconsciously examine it with his own knowledge, and will then much overrate its value. The Blue-Book rightly lays stress on the value of rough blackboard sketches, particularly if they are copied by the class. These are effective because they grow under the eyes of the children, and because they contain only the essential features, ignoring the unimportant. Much may be learnt from pictures concerning arms, clothing, and so forth; but the art of learning from pictures needs to be taught just as does that of learning from books. But "nothing appeals more to the imagination of an intelligent boy or girl than a visit, under skilful guidance, to the actual places associated with the great men and deeds of the past." Considering the comparative ease with which such visits can be made in many parts of this country, and the importance always and rightly attached to them, it is a pity they are not more common.

5. Make use of recitations, songs, and anniversaries. Recitations certainly are useful, and probably most teachers use them, though not much can be learnt in this way, as the number of subjects treated is strictly limited, owing to the number of lines learnt. The recurrence of anniversaries is used in many schools, and is certainly effective as far as it goes. The difficulty is where to find time, unless we take only a very few, as in most schools all odd minutes are fully taken up with such subjects as mental arithmetic and spelling; and if we give up the regular history lessons on such occasions, we shall make but little solid progress in history. In this connection we notice a suggestion with regard to the elder scholars. "If the affairs of a foreign country for any reason attract great public attention, the teacher should feel at liberty to depart from his general scheme, in order to give a few lessons on the history of the country or countries in which the scholars are for the time keenly interested." The advantages and drawbacks are precisely the same as with anniversaries; the boys are interested, and therefore will be attentive and will learn, and they will appreciate the fact that history is a living thing, and not merely the record of a dead past; on the other hand, the loss in steady progress is to be regretted.

6. "Each teacher is at liberty to frame that scheme of instruction which shall best accord with his own skill and capacity." The wisdom of these words is recognised by many headmasters. They remind one of the saying, which has considerable truth in it, that that form of government is the best which is best administered.

7. "Specialists may give lessons on the history of other countries." For reasons which we have given above, we should go much further than this, and say that in every school where history is taught lessons should be given on the history of other countries. One does not need to be a specialist for this purpose, and unless it is done boys will have a strange idea of history. They will think that at a few times, such as during the War of the Spanish Succession and during the French Revolution, foreign countries had a history, but that, generally speaking, they were in a state of passive existence. Most of us give such lessons. We let boys see that the Northmen invaded other lands beside England, and that the Black Death devastated other countries besides our own; but the teaching of European history should not be merely incidental.

With regard to younger children—

1. "English history should be an inheritance of childhood." The characters and incidents should "grow into their thoughts."

2. Deal with important persons and events. These are more attractive to children. But secondary matter is needed as a background.

3. Maps help the impression of truth.

4. Broad generalisations are unprofitable.

Little comment is needed, as we have dealt with these points. They indicate what should be the aim of the teacher with young children. Generalisations must follow, not precede, the acquisition of facts.

And with older scholars—

1. Give easy home exercises.

2. Quiet reading is necessary. Children should have access to standard books, for the teaching is not effective unless it demands some independent study in the higher classes.

3. Keep a chronological chart for local events. Lead the scholars to take an intelligent interest in current affairs, and to see that history is a record of movements in which each has a part.

Here, again, comment is almost superfluous, as the wisdom of these hints is patent. The one remark we make is, that at first careful guidance is necessary in the independent reading. If this is given, then later on children will be able to "taste the supreme pleasure of finding out things for themselves" (p. 122). There is generally far too little quiet reading and independent study in elementary schools; as a rule, we do far too much for our pupils.

(*To be concluded.*)

THE TEACHING OF ENGLISH LITERATURE.

THE importance of this subject is beginning to receive its due recognition. Educational authorities are realising that no other subject is so humanising and refining, and that no system of education is complete which does not involve a study of some of the greatest authors. For many years the English papers set at the Scholarship and Certificate Examinations have been becoming more and more literary; the subject occupies an important position in the curriculum of every secondary school; and even in elementary schools an attempt is being made to impart to the boys and girls a certain amount of literary taste. Nor is the task a hopeless one. Nearly all children are born poets. Their love of rhythm and of rhyme is indicated in the avidity with which they listen to nursery rhymes and nonsense verses; their wealth of fancy is shown in many of their games. Most children, like most adults indeed, are very slow in finding out the beauties of good literature for themselves, but they are almost as quick in seeing such beauties when these have been pointed out to them.

My first experience in this direction was with a class of Standard VI. boys. They were taking *The Merchant of Venice* as a reading-book, and I set myself to try how far they could be made to take an intelligent interest in the play. The experiment was more successful than I had hoped. The boys soon became interested, not only in the plot, but in the characters. Before we had got half-way through the story, some of them could tell me what light certain actions or speeches threw on the character of the man or woman who performed or uttered them; they could pick out the finest passages in the play and read them with intelligence. Further experience with older students has shown me that in secondary schools and pupil-teacher centres a little judicious guidance is sufficient to foster in the pupils such a love of poetry as shall lead them to choose for their prizes Tennyson and Shelley rather than popular authors of inferior merit.

The first essential in teaching Literature is enthusiasm. If a man believes, as I have heard teachers say, that Tennyson wrote twaddle, and that most of the professed admiration for Shakespeare is hypocritical, he had better confine himself to the teaching of mathematics and science. It is better to go to the extreme of believing that the book one is reading with a class is the most delightful book ever written, than to be eager to find fault with it. Let the teacher of Literature remember Matthew Arnold's definition of criticism, "A disinterested endeavour to find out the best that has been thought and written in the world," and let him take care that his pupils see as much of "the best" in the work they are studying as they possibly can.

The second essential is the power to read well. A good reader can transform an apparently uninteresting poem into a thing of beauty and delight. Without making a single comment he can *suggest* the beauty of a stanza from Keats by modulating his voice in such a way as to bring out the melody, and by showing how deeply he himself is drinking of the charm. But this power cannot be acquired in a day. It needs a careful study of the poets and a knowledge of their peculiar styles. And here perhaps is the place to insist that the Literature lesson should be kept quite distinct from the reading lesson. The ends are quite different. In the former the reading should be done by the teacher, and should be used to bring out the force and beauty of the poetry or prose under consideration; in the latter, practice in reading on the part of the pupil is almost everything. But in the name of all the poets at once, don't give him Milton or Shelley to practise upon; the daily newspaper will do just as well. A lot of nonsense is being talked to-day about developing the originality of the student. As a matter of fact the nearer a reader gets to the meaning of his author the better will his reading be—and the less "original."

A third requisite is general knowledge. One of the disadvantages of English poetry, from the point of view of the ordinary reader, is the large number of classical allusions. But a teacher who is familiar with the stories referred to (or even knows how to use a classical dictionary) can make almost every one of these a gateway into fairyland. To students between the age of ten and twenty the story of the Argonauts, of Orpheus and Eurydice, of the wanderings and return of Ulysses, are more interesting than any of the tales of Grimm or Andersen; and I have known a few references in the poets make a class of senior boys eager for Roman and Greek history.

Even etymology and the study of figures of speech become tributaries to the interest of a poem when they are used as a means and not as an end, and are therefore introduced sparingly. When you have explained the etymology of "extort," for instance (*ex*, out of; *torqueo*, *tortum*, I twist), your class will be able to appreciate the skill with which the word is used by Cowper in the sentence:—

> "Nations would do well
> To extort their truncheons from the puny hands
> Of heroes."

With a little guidance even comparatively young students may be led to criticise intelligently the use by a great poet of a certain word or phrase, and to admire those passages which are most admirable. They will take an interest in similes, metaphors, and alliteration, and will positively revel in onomatopœia. Try them with Tennyson's:—

> "Shocks, and the splintering spear, the hard mail hewn,
> Shield-breakings and the clash of brands, the crash
> Of battle-axes on shattered helms;"

or,

> "I heard the ripple washing in the reeds,
> And the wild water lapping on the crag;"

or read for them the first three stanzas of the *Ode on the Death of the Duke of Wellington* in such a way as to bring out the suggestion there is of the sound of the tramp of feet, of the tolling of bells, and of the heavy boom of cannon.

Some years ago the Code arranged for the introduction of pupil teachers to the study of poetry by way of the Sixth Canto of Scott's *Marmion*. And a capital introduction it affords, not only for pupil teachers, but for the scholars of secondary schools. The thoughts are not profound, the feeling is not deep, many of the rhymes are very faulty, but the rhythm is exhilarating and the pictures vivid. Macaulay's *Lays of Ancient Rome* are also suitable for a first course. For a second I strongly recommend a collection published by Macmillan known as *The Poet's Walk*. The editor, an old Etonian, has endeavoured to select such of our greatest lyrics and extracts as are best suited to the joyous spirit of youth, and the result is a volume which ought to be read by every boy and girl in England. This may be followed or replaced by the two charming little volumes (sixpence) known as *The Hundred Best Poems*. Some of the lyrics, of course, deal with experiences beyond those of young students, but in that there are some advantages. Such anthologies as these may be supplemented by several of the *Penny Poets*, or some other cheap selections in which occur a larger number of poems by the same author.

By this time the student will be ready for Shakespeare. His reading of other poets will have prepared him for the appreciation of Shakespeare's noble language, while the study of character and incident will come as a delightful change. There is no better play to begin with than *The Merchant of Venice*, and this may be followed by *Julius Cæsar*, or *Henry V.*, or *As You Like It*. If you think that even in school editions of Shakespeare there are passages which girls ought not to read, let me beg you to consider carefully these words of the great moralist[1] who took so keen an interest in the education of girls: "Whether novels, or poetry, or history be read, they should be chosen not for their freedom from evil, but for their possession of good. The chance and scattered evil that may here and there haunt or hide itself in a powerful book never does any harm to a noble girl; but the emptiness of an author oppresses her, and his amiable folly degrades her." Moreover, when a girl has learned (and the reading of Shakespeare and of the Bible in class will help her to learn) that an indelicate phrase or sentence is a thing to be passed over without comment or notice, she has done much towards acquiring those habits of moral discipline which form the backbone of character.

To inculcate a love of the best prose is a more difficult matter; but much may be done by careful selection, and by taking care that the pupils are not called upon to struggle with difficult passages which have not been read for them by the teacher.

Arnold's Reprints give, in a very cheap form, selections which are just long enough to give the reader a grasp of the style of a particular author. But the works of the great stylists must be administered very cautiously. For the purpose we are now considering Boswell is better than Johnson, and Froude than Macaulay. Extracts from Gibbon's *Autobiography* are likely to prove more attractive than any from the more famous *Decline and Fall*. The young student, however, need not trouble much about these if he has carefully read the *Sir Roger de Coverley* papers, half-a-dozen of the *Essays of Elia* (such as "Old China," and "Dream-Children"), and Ruskin's *Sesame and Lilies*. These, together with the poetry already mentioned, are sufficient to form the foundation of a sound literary taste.

[1] John Ruskin.

OUR ILLUSTRATED GEOGRAPHICAL NOTE-BOOK.

HOLLAND.

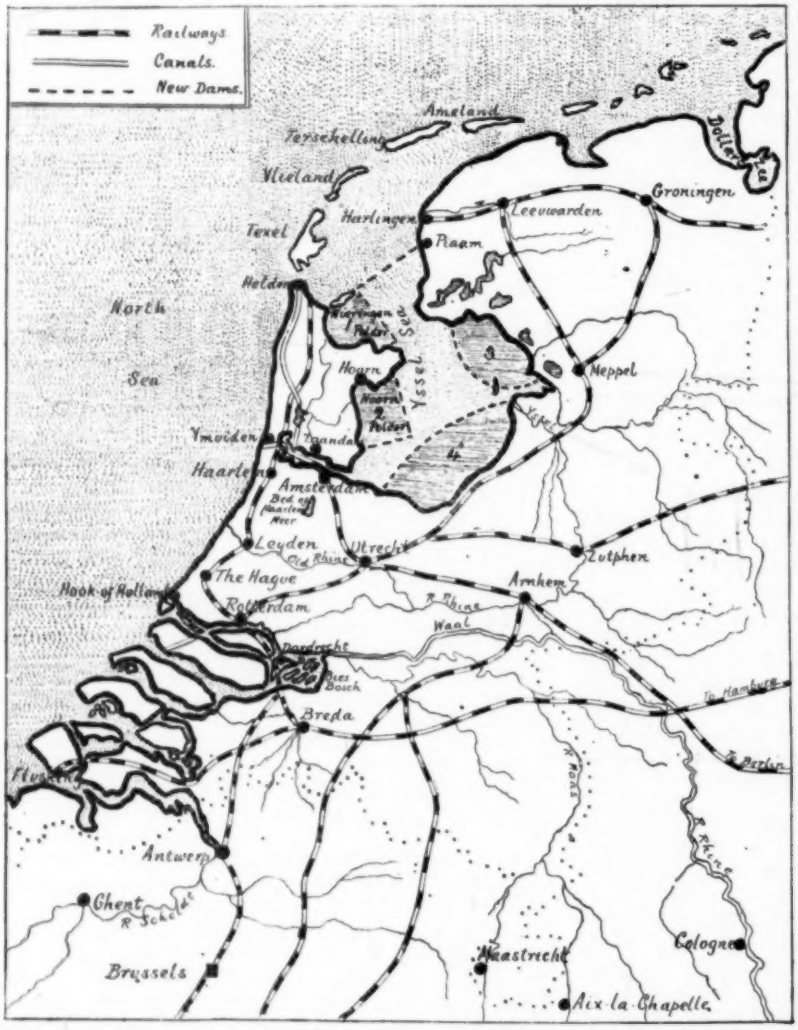
The Making of Holland.—The rise and progress of the Dutch is a particularly interesting feature in European history. During the long period occupied by the evolution of the Continental states each nation had its own peculiar internal or external difficulties; the Spaniards were troubled by the Moors, and the Greeks by the Turks; the French for centuries were harassed by the English; and the Germans had the conflicting interests of numerous petty states that awaited Bismarck to weld them into a homogeneous whole. But the Dutch had a heavier burden, for not only did they have to struggle for their independence against the Spaniards and the Austrians, the English and the French, but they had to maintain a continual combat with the Atlantic Ocean.

The Romans made the Dutch, or Batavi as they called them, their allies, instead of conquering them as they did their near neighbours; and probably this early association with the Romans encouraged a spirit of independence that stood the nation in good stead in later times of stress and oppression.

In due course the seventeen provinces that are now Holland and Belgium became a part of the Holy Roman Empire, but they gradually secured at least a semi-independence, their chief offices becoming hereditary and descending from father to son. Just when complete independence seemed assured in 1434 the country was seized by Philip of Burgundy, a leading division of France, which had not then completed its unification. It was through the house of Burgundy that in later years the Netherlands became attached to the Spanish Crown under Charles V. Now, the Dutch and the Spaniards possessed no single common characteristic upon which to build up a mutual understanding. The Dutch had followed the teachings of Luther from the very outset, and yet in 1565 was suddenly introduced into their midst the Inquisition with all its attendant horrors. In quite a short period 100,000 Dutchmen suffered death by burning for the sake of their religion, a very solid reason for the intense hatred of the Spaniards which thenceforth marked the attitude of the northern people towards their southern oppressors.

William, Prince of Orange (William the Silent), was at this time the governor of the province of Holland. Though a Catholic his religion did not blind him to the sterling character of the Dutch; and eventually he became a Protestant and their champion in the struggle for freedom. In 1572 the Duke of Alva was

sent to reduce the rebellious Protestants, and the country suffered all the evils of a hotly contested campaign. The manufactures and commerce that had steadily been built up were ruined; Prince William was forced to flee from the country; and general confusion and misery took the place of order and commercial prosperity. William organised armies



abroad, and returned to assist the national cause; but it was the establishment of a naval force that secured to the Dutch the command of their own seas, and enabled them to bring about a final and complete separation of the seven northern provinces from Spain.

The assassination of William the Silent at the instigation of Philip of Spain did not aid the Spanish cause, for his son, Maurice of Nassau, proved a capable successor. The Spaniards were glad to agree to the Truce of Antwerp—an armistice for twelve years. This period of rest was used by the Dutch to repair the ravages made in their trade and commerce. Only in 1648 did the Peace of Westphalia signalise that the independence of Holland was recognised by the whole of Europe.

But the troubles of Holland were by no means at an end, for in later years she became involved in war with England. De Ruyter defeated the English and sailed about the English Channel with a broom at his mast in token of how he swept his enemies from the seas; and Van Tromp sailed up the Thames and burned British ships just off Chatham. In the end, however, the Dutch were glad to make peace, for the prolongation of the war was ruining their commerce and altogether adverse to their colonial interests.

In 1689 the English expelled James II., and in his stead took for a ruler William of Orange, a descendant of William the Silent, who had married Mary, a daughter of the deposed monarch.

The evil star of Holland again became in the ascendant. Fresh quarrels with England resulted in the loss of Ceylon, and in 1794 a worse fate befell her in the annexation of the Netherlands by France. With the downfall of Napoleon the then Prince of Orange became ruler of the seventeen united provinces of Holland and Belgium. In 1831, however, Holland and Belgium became separate countries as they are to-day.

That Holland has maintained a separate existence is a standing testimony to the courage, determination, and self-sacrifice of her people. Her territory is viewed with covetous eyes by the Germans at least. Germany is hampered by lack of open sea coast, which the seaboard of Holland would satisfactorily remedy. The Dutch colonial empire, too, would give to Germany the foreign possessions she so ardently desires, and which her own late unification did not allow her to gain for herself. Pessimists foretell that the map of Europe half a century hence will show the absorption of Holland by her powerful neighbour. But the Dutch would no more passively yield to Germany than they did to Spain centuries ago, and in maintaining her integrity she would certainly receive the assistance of Britain and France, neither of whom desire Germany for a nearer neighbour. Herein, perhaps, lies Holland's chiefest safeguard, and it is probable the Dutch will be left in peace to enjoy the land for the possession of which their forefathers spent their blood and treasure through long centuries of cruel warfare.

General View.—Holland, the hollow land, as the name signifies, is the lowest part of the great plain of Europe. It is a flat country, and quite one-third of its area is actually below sea-level. The soil consists mainly of the alluvial deposits of the rivers Rhine, Maas, and Scheldt, whose mouths deeply trench

the country. There is no single elevation; there are numerous depressions of considerable extent. There are no minerals except clay and fuller's earth; but there are extensive beds of peat. About three-fourths of the land is available for agriculture. The soil is moist and yields rich pastures which support a large number of cattle considering the limited area available. The dairying industry is consequently of great importance. Some of the polders, land reclaimed from the sea, are especially fertile. Rye is the chief cereal, but flax, mustard, chicory, and madder are important. Flower-bulb cultivation, particularly in the neighbourhood of Haarlem, is a flourishing industry. Dairy-farming is a staple source of wealth, as indexed by the exports of butter, cheese, margarine, milk, and eggs.

Notwithstanding the absence of minerals, manufactures are of considerable importance. The country is a network of navigable rivers and canals, and cheap transit enables fuel and raw materials to be brought into the country and still leave a margin for profit. The length of navigable waterways is twice that of the railways; it is possible to travel by water over the whole of the country. *Shipbuilding*, when wood was the chief material, was a more important industry than in most countries, and even in these days of iron and steel vessels, Holland is fifth in the world in its annual output of shipping tonnage. *Textile industries* are largely pursued; Tilburg, Utrecht, Enschede, Almelo, and Hengelo are the chief towns engaged. The large yield of rye gives rise to an immense *distilling industry;* at Schiedam alone are 200 gin distilleries. *Diamond-cutting* is a specialised industry at Amsterdam, which is second only to London as a diamond market. *Tobacco and snuff* are largely made, chiefly for home consumption, for the Dutch are inveterate smokers. *Earthenware* has declined, but the famous Dutch delftware is still largely in demand.

The National Menace.—Portions of Holland are quite 25 feet below the level of the sea, which is only kept from overwhelming the country by the provision of immense dykes and dams, the most notable of which are round the west coast of Walcheren and near the Helder in North Holland. The chain of islands running north-east from Helder marks the line of sea coast perhaps 2000 or more years ago. The Dollart Zee was not in existence in the middle of the thirteenth century.

Zuyder Zee.—Until 1282 its centre was a lake discharging its waters by a river 50 miles long. Then the ocean broke through and separated Friesland from North Holland, and in later times the sea encroached until it covered an area 80 miles long by 20 to 40 miles broad. Over 80,000 persons are said to have lost their lives by the formation of this sheet of water. The province of Groningen once lost 44 villages and all their inhabitants, and only 200 years ago the same province lost over 1500 houses at one swoop. In 1892–94 a State commission proposed to drain the whole of the Zuyder Zee at a cost of £31,000,000, including compensation to displaced fishermen. The plan was viewed as impracticable, but a partial scheme is now in progress to reclaim a great portion of the land so long swayed by Father Neptune. The shaded portions numbered 1, 2, 3, and 4 on the accompanying map are the areas marked out for reclamation during the next two decades. From Wieringen Island to Piaam is being constructed a huge dam, 17 miles in length, at each end of which are locks. Nine years will be occupied in building the dam, along which a railway will be laid; this will bring Leeuwarden 31 miles nearer to Amsterdam. Wieringen and Hoorn polders will then be cut off from the sea by means of dams as indicated in the map; these alone will yield 115,000 acres of cultivable land, the sale of which will go a long way towards the ten million sterling the work will cost. The work on polders 3 and 4 will not be commenced until the Wieringen and Hoorn works are at least partly completed. The old Dutch saying that "God made the sea but the Hollander the land," has been exemplified many times in the history of Holland, but never upon so gigantic a scale as this present undertaking.

Haarlem Meer.—At the end of the sixteenth century an irruption of the sea merged several small lakes into one sheet of water 45,000 acres in extent. During storms the lake rose and threatened the safety of Amsterdam and Leyden, and the removal of the danger was undertaken. First a canal was constructed all round the lake. England supplied several pumping engines, one of which lifted 112 tons of water per stroke, or nearly a million tons per day. Pumping commenced in May 1848, and by July 1852 the 70 square miles of water, 15 feet deep, had been carried off to the sea by the canal. The drainage cost £1,000,000, but the sale of the new land realised three-quarters of this amount.

It is, however, not only the sea that continually threatens the safety of Holland. Danger lies, too, in the rivers, the very presence of which, as commercial gateways to Central Europe, gives the country so favourable a position for commerce. The Rhine on entering Holland is 2000 feet wide. It sends off two branches, the Yssel to the Zuyder Zee and the Waal to the Bies Bosch. The delta of the Rhine, 4000 square miles, is the largest in Europe. Owing to the great amount of sediment the banks of the streams have to be raised to protect the surrounding country from floods. The meadows are not infrequently 10 to 12 feet below the river banks, and the same obtains in regard to many of the canals. It is in spring that the rivers are the greatest source of danger. The winters are more severe than in England, and when the frost breaks up the blocks of ice sometimes form a "jam," which stops the flow of the waters, causing them to overflow their banks. In 1491 the Bies Bosch was formed in this way; 72 villages were submerged and 100,000 persons lost their lives. In 1855 the Rhine burst its banks in five places, and flooded the whole region between Utrecht and Zutphen; and smaller calamities have occurred with distressing frequency.

To fight the inroads of water, whether from sea or river, occupies the energies of the Waterstaat, a public department under an independent minister of the Crown. Hydraulic engineering is the chief feature of the work; reclaiming land from the sea, and the care of the dykes also fall under this department. But if the presence of a superabundance of water is a menace, it can also be utilised as a defence against foreign foes. In the struggle with the Spaniards the Dutchmen on several occasions opened the sluices and flooded the region where the enemy lay; and in modern times this method enters largely in the Dutch scheme of defence against possible invaders.

The Rise of Dutch Commerce.—The industrial and commercial importance of Holland dates back to the

Middle Ages, when the manufactures of textiles in particular commenced to be largely pursued in the north-west corner of the Continent. In the earlier days the trade with Portugal was a special feature, for the Portuguese were the great Eastern adventurers, and Lisbon was the chief market for the varied products of the East Indies. The seizure of Portugal by Spain in 1580 was a great blow to the foreign trade of Holland, but the Dutch, with that doggedness that is such a marked feature of the national character, determined to go to the East themselves. Failing in an endeavour to reach India by way of the Arctic Ocean, the Dutch formed trading companies that trafficked via the Cape of Good Hope. There they speedily became involved in warfare with the Portuguese, but the Hollanders held their own, established a settlement in Java, made friends with the natives of some of the islands by expelling the Portuguese for them, and opened up Amboina, Banda, and other islands.

In March 1602 was formed the Dutch East India Company, only two years later than the great British Company was established for trading with the East. The Dutch Company employed at one time 15,000 sailors, and possessed 180 armed ships to protect its interests. The Dutchmen founded factories on the Coromandel and Malabar coasts of India, and built Batavia in Java. Then came collisions with the English, who were busily exploiting these regions. But the Dutch met with marked success. They drove the English out of Banda Islands, seized Timor, and took from Portugal the island of Ceylon and Malacca. They traded with Japan as early as 1638, a privilege not allowed any other European nation at this time. In Amboina occurred an incident discreditable to Dutch methods of furthering their colonial policy. After the Portuguese were driven out the English retained five stations ostensibly under the protection of the Dutch, who basely massacred all the English settlers, on the plea that they were conspiring with the natives against Dutch rule.

In later times the rise of the British into commercial prominence robbed the Dutch of a great portion of their carrying trade, and the quarrels that ensued brought disaster to the Hollanders. Their world-wide possessions, for they had secured territory in various parts of the New World, were at various times held by England and France; the East India Company and the Bank of Amsterdam failed; early in the nineteenth century a great inundation caused great loss and distress; and commerce was at a standstill. After the separation from Belgium the Dutch made a determined effort to restore their fallen fortunes. Manufactures were revived; agriculture received a new lease of life; land was reclaimed from the sea; canals and railways were constructed; and advantageous commercial treaties were made with other peoples. The measure of their success is shown by the present volume of trade:—

1904.	
Total Imports	£201,627,000
From Britain	21,062,000
Total Exports	165,465,000
To Britain	36,115,000

A great feature of Dutch trade consists of goods in transit, *e.g.* in the exports iron and steel figure to the value of over £4,000,000, most of which is of German manufacture. The Dutch home exports to Britain are chiefly agricultural and dairy produce; margarine amounts to over £3,000,000; butter about half as much; and cheese, milk, eggs, &c., in large quantities.

The Dutch Colonial Empire.—The most valuable Dutch possessions are in the East Indies. They consist of the whole of the Sunda Islands, except small portions of Borneo and Eastern Timor, together with Western Guinea. In Java and Madura Dutch government is unchallenged; but in Sumatra, Borneo, Celebes, and other islands, many of the districts are ruled by the native princes with the assistance of a Dutch Resident. The Dutch sovereignty in such cases is often merely nominal. In the north of Sumatra the Achinese have resisted Dutch domination for centuries, during which long period hostilities have practically never ceased. Their hold on the East Indies give the Hollanders the major portion of the European spice trade. The trade of Java, Madura, and other outlying islands amounts to not less than £32,000,000 per annum.

In South America Dutch Guiana lies between the British and French possessions of the same name. Curacao and several other small islands complete the Dutch territory in the New World.

Miscellaneous.—*Amsterdam*, the capital, is built on piles. The city is so intersected by canals as to necessitate 300 bridges. Shipbuilding and diamond-cutting are the chief industries. *The Hague* is the political capital and seat of government. *Rotterdam* is the chief port and the great market for colonial produce. A new waterway, just south of the Hook of Holland, has greatly added to shipping facilities. *Flushing* and *Hook of Holland* are the chief passenger ports of entry.

Windmills, used for pumping in the drainage of the land, are always an outstanding feature of the Dutch landscape. There are said to be 10,000 at work in the country, and in the neighbourhood of Zaandam alone there are over 1000. The province of Luxemburg was conferred on the King of Holland in 1815, but it is neutral in time of war. The stork is jealously cared for by the people, owing to its usefulness in destroying frogs and worms that are injurious to the dykes. In winter women go to market and children to school along the frozen rivers and canals on skates. The Dutch were the first to realise the economic importance of the Jews; they were welcomed in Holland at a time when they were completely banished from England. Simplicity is a great feature of the national life; the people are sober, industrious, and thrifty. Poverty and suffering are almost unknown; there are all kinds of benevolent institutions, and yet there are no poor rates. There is no unemployed problem in Holland; mendicity and vagabondage are criminal offences, and convicted persons are placed in State-work establishments. In this respect at least Britain has something to learn from her ancient rival.

Holiday Courses on the Continent (for Instruction in Modern Languages).—The Board of Education have just issued a list of twenty-five holiday courses which will be held on the Continent at different times during the present year, but mostly in the summer months. Six of the courses are in Germany, four in Switzerland, one in Spain, and the rest are in France. The paper issued by the Board of Education gives the date of each course, the fees, return fares from London, lowest cost of boarding, principal subjects of instruction, address of local secretary, and other details of importance to intending students. Copies of the paper can be obtained free on application to the Board of Education Library, St. Stephen's House, Cannon Row, Whitehall, London, S.W.

HUNTING SONG.

Words by SIR WALTER SCOTT. *Music by* THOS. J. HEWITT.

Moderato.
PIANO.
f con brio.
mp
p
TREBLE. Key C.
f
d' :t .l |s :f .m |r :s |d :— |m :- .f |s :l .d' |t :l |s :— }
1. Wa - ken, lords and la - dies gay, On the moun - tain dawns the day;
ALTO.
f
d' :t .l |s :f .m |r :s |d :— |d :- .r |m :m |r :d |t, :— }
1. Wa - ken, lords and la - dies gay, On the moun - tain dawns the day;
f
mf
r' :d' .t |d' :s |l :s .f |m .f :s |r' :d' .t |d' :s |l :s .f |m .f :s }
All the jol - ly chase is here With hawk and horse and hunt - ing spear;
mf
f :f |m :d |f :m .r |d .r :m |f :f |m :d |f :m .r |d .r :m }
All the jol - ly chase is here With hawk and horse and hunt - ing spear;
mf

Hounds are in their cou - ples yell - ing, Hawks are whist - ling, horns are knell - ing,
Hounds are in their cou - ples yell - ing, Hawks are whist - ling, horns are knell - ing,
Mer - ri - ly, mer-ri - ly min - gle they, Wa - ken, lords and la - dies
Mer - ri - ly, mer-ri - ly min - gle they, Wa - ken, lords and la - dies
Horn. ff
gay.
gay.
pp Echo.

2. Wa - ken, lords and la - dies gay, To the green - wood haste a - way;
3. Lou - der, lou - der chant the lay, Wa - ken, lords and la - dies gay!
2. Wa - ken, lords and la - dies gay, To the green - wood haste a - way;
3. Lou - der, lou - der chant the lay, Wa - ken, lords and la - dies gay!
We can show you where he lies, Fleet of foot and tall of size;
Tell them youth and mirth and glee Run a course as well as we;
We can show you where he lies, Fleet of foot and tall of size;
Tell them youth and mirth and glee Run a course as well as we;
cres. . . . .
We can show the marks he made When 'gainst the oak his ant - lers fray'd;
Time! stern hunts - man! who can baulk, Staunch as hound and fleet as hawk;
cres. . . . .
We can show the marks he made When 'gainst the oak his ant - lers fray'd;
Time! stern hunts - man! who can baulk, Staunch as hound and fleet as hawk;
cres. . . . .

You shall see him brought to bay; Wa - ken, lords and la - dies
Think of this, and rise with day, Gen - tle lords and la - dies
You shall see him brought to bay; Wa - ken, lords and la - dies
Think of this, and rise with day, Gen - tle lords and la - dies
gay.
gay.
gay.
gay.
End of Second Verse.
End of Third Verse.

Our Modern Language Section

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than May 8th, 1906**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

La philosophie est à nos yeux la science de la nature humaine considérée dans les faits qu'elle livre à notre observation. Parmi ces faits, il y en a qui se rapportent plus spécialement à l'intelligence, et que pour cette raison on appelle communément métaphysiques. Les faits métaphysiques, les phénomènes par lesquels se manifeste l'intelligence humaine, ramenés à des formules générales, constituent les principes intellectuels. Les principes se peuvent envisager sous deux aspects: ou relativement à l'intelligence dans laquelle ils existent, au sujet qui les possède, à la conscience et à la réflexion qui les considèrent; ou relativement à leurs objets, c'est-à-dire non plus en eux-mêmes ni en nous-mêmes, mais dans leurs conséquences et leurs applications. Qu'on y pense; tout principe intellectuel se rapporte à l'esprit humain; et en même temps qu'il se rapporte à l'esprit humain, sujet de toute connaissance et de toute conscience, il regarde des objets placés en dehors de l'esprit qui les conçoit; et, pour me servir d'expressions fameuses, commodes par leur concision et leur énergie, tout principe intellectuel est subjectif ou objectif, ou subjectif et objectif à la fois. Il n'y a aucun principe, aucune connaissance, aucune idée, aucune perception, aucune sensation, que n'atteigne cette division générale, laquelle partage d'abord tous les problèmes philosophiques en deux grandes classes; problèmes relatifs au sujet, problèmes relatifs à l'objet.

From "Premiers Essais de Philosophie," by
VICTOR COUSIN.

RESULT OF THE APRIL COMPETITION.

The prize is awarded to "Sarum." (Will "Sarum" kindly forward name and address for publication?)

First Class.—Nolle, Hazard, Josiah, Devanka, Eicarg, Jabberwock, Honoré, Comet, Agaznog, Stuart, Carpe diem, J. M. R., Gawayn, Grimbarian, Dim, Dunnottar, Mergy, Bog Violet, Shakspere, Raymond, Bees, Periwinkle, Thirlestane, Pentyla, Almighty Dollar, Oncet, Gargunnock, Zelda, Phil, Padova, Montrose, Dareska, Brigitte, Molly, Nehemiah, Cinerea, Le petit chose, Tulipe noire, Kettering, Peggy, Winnowsty, Aquina, Marta, Ariadne, Carol, Resurgam, Dlawso, Sissy, Rus, L'aile, Sweet Nell, Chaos, Summerbank, T. W. D., Libnos, Pepita, Lenias, Malta, Beryl, H. W., William Morris, Joli Cœur, Prague, Whippersnapper, Bluebell, Vivienne, Philomène, White Rose, E. S. L. A., Raema, Floramutch, Stonefield, W. M. E., A. G. M., Gledfield, Golcar, Octavia, Rosalind, Lalla Rookh, ——, Troisième, M. A. G., Sandow, Einna, Bobby, Achilles.

Second Class.—Hazelwood, Stornoway, Offiniac, R. B. Helaz, M. E. K., Desaig, N. Hawthorne, Northwood, Malingear, Rusness, Marie, Theodora, E. M. B., Raymond Legros, Chênes, Noçam, Ingogo.

Received too late for classification—Danella.

The name and address of "Thekla," the winner of last month's competition, are:—Miss Mabel Beaton, 15 Muirhall Terrace, Perth, N.B.

Report.

The number of really good translations is large. The general idea of the piece was very easily grasped, but *en tant que cerveau* puzzled a few, who translated it as "so many showing no intelligence," "as long as he is intelligent," "no one has more admiration than myself *for a considerate husband*," etc. *Sur cinq francs, etc.*, was curiously rendered in two cases: "On five two only can claim help," and "Out of five francs only two become paupers." *Hôpitaux* is rather "almshouses," or "workhouses," than "hospitals."

Prize Translation.

I never uphold that feminism which has for its doctrine the hatred of the stronger sex, but I do support that which demands for women a share in the management of the world's affairs. As far as intelligence goes, no one has more admiration for man than I. As I behold him erecting the piers of a bridge, or tunnelling through mountains, snatching nature's secrets from her one by one, I feel very insignificant; the burden of his appointed task fills me with a mother's pity. But I also see that he cannot accomplish all things; and if woman is essential for the completion of his private life, she is equally so for the completion of his work. She is quite able to help him in fighting against consumption and alcoholism, in building healthy dwelling-places where children may freely thrive. There is too much suffering from cold and hunger, too much wickedness and immorality in the world that is governed by man only. Public charity is so mismanaged in our land that out of every five francs contributed, two only reach the needy—two, mark!

The hospitals of France are a disgrace to her. It is time, high time, for woman to exert an influence over these things within her ken, for after all, she is our mother. She only should be appointed to assuage the wounds of those who have suffered in life's battle, and to relieve the wants of the poor. For this work she must needs be trained; the training should form part of every girl's education—and it will, in time. Nature has made the Saxon woman the pioneer; the Saxon woman has cleared the way, but the movement is as yet lacking in that enthusiasm and idealism which only the women of the Latin and Slav races possess. And nature will soon utilise these admirable forces; indeed, if I am not mistaken, she is already doing so. SARUM.

OUR TUTORIAL SECTION

NEW SCHOLARSHIP COURSE FOR 1906-7.

BY ARTHUR T. FLUX,

Late Principal of the Belvedere Pupil Teacher Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

First Month—May.

In commencing a new course for the Scholarship Examination, it is necessary to preface the notes by a few remarks to those who propose to follow the scheme of work set out in these columns.

The course is intended as a help to those candidates (and they are many) who cannot obtain regular instruction at a centre, and also to those who, attending a centre, are desirous of benefiting by a double course.

The essentials to ultimate success are comparatively few. (1) Each candidate must possess good, up-to-date text-books; (2) the preparation must be steady and consistent, there must be no cramming at one time and indifference at another; (3) whatever is done must be done thoroughly and systematically. This involves the drawing up of a time-table, which, when rendered suitable by necessary modification, must be rigidly adhered to.

In the course we propose to divide the work up into monthly sections, adding such notes and explanations as seem necessary, directing attention to the most salient points, and providing a means of testing progress by test questions, selected generally from recent examination papers. Any one following carefully the instructions given in these columns need have no fear of the examination.

I would particularly request all candidates to communicate with me direct upon any point in connection with their work which presents difficulties—text-books, time-tables, difficulties experienced, etc.—as it is obviously impossible to deal with *all* these points through the columns of any journal. Letters will receive prompt and careful attention. Specimens of work should also be occasionally submitted for criticism.

The Subjects of the Examination.

These will be found detailed in the syllabus, which may be obtained gratis from the Board of Education. Briefly, the examination is in two parts. Part I. (December)—Reading, Repetition, Penmanship, Composition, Arithmetic, Drawing, Music, and Needlework. Part II. (April 1907)—A. *Compulsory:* English Language and Literature, History, Geography. B. *Optional:* One or two Languages, Elementary Science, Elementary Mathematics. Candidates *may* offer more than one of these optional subjects, and doubtless many students will offer French, Science, and Mathematics. In any case, *two* optional subjects should be attempted. More is said of each subject seriatim below.

Work to be Prepared.

1. *Reading.*—There is no specified book, but the student is expected to read "with clear enunciation, ease and intelligence" from any standard prose or poetry book. This subject—usually neglected—is of course very weak. There are very few really good readers. The mere production of successive words correctly is a very small part of the exercise, and even this is often not well done. To read with ease and intelligence a passage say from Macaulay involves a quick appreciation of argument and meaning which can only come by assiduous practice. Good reading depends mainly upon two things—(1) correct pronunciation; (2) correct emphasis. The former can only be attained by *oral* practice. You cannot become a correct reader by silent reading any more than you learn freehand by looking at copies. There are certain mouth and throat muscles which *must* be trained. The latter depends upon general education. In addition then to as much general reading as possible, the student should take ten minutes' practice each day orally before a competent critic if possible.

2. *Recitation.*—One hundred lines of poetry or prose. The above remarks apply equally to repetition. Verbal correctness, though absolutely necessary, is not enough, the author's meaning must be conveyed by proper emphasis and modulation. In selecting a passage to learn, Shakespeare teems with suitable pieces, but is not necessary to select from Shakespeare. Any piece from a standard author may be chosen to suit the individual tastes of the candidate. Learn twenty lines for this month.

As memory is developed by exercise, I would strongly advise the student to learn *any* passage or poems which appear worthy of being remembered. There are many anthologies of verse published, and in Macmillan's *Golden Treasury* will be found some of the gems of English poets.

3. *Penmanship.*—This is the easiest of all subjects to learn, and therefore the one most neglected. Not five per cent. of the papers I examine are really well written. If the examiners insisted upon the writing being up to the Civil Service standard, there would be a rapid improvement. There must be good paper, good ink, and a suitable pen. Brandauer's circular pointed pens are made in sufficient variety to suit every one. Take a suitable model and learn the correct shape of the letters, and *always try to make them* exact. This may be tedious at first, but is a habit easily acquired. Too frequently the "copy" is an entirely different style from the ordinary writing—a mute confession that the latter is not good enough. Get the *Practical Teacher Copy Book*—specially prepared for the examination—and write a page in it daily, and above all use care at all times. Careless scribbling is fatal to good writing.

4. *Composition.*—This is tested not only by a formal essay, but also by the general style of the answers. The subject is, in a written examination, of the very highest importance, and one demanding unremitting care and attention. Although many books have been written on the art of writing English, there is no royal and easy road to success. There are many valuable hints, rules, and suggestions, but the basis of the whole exercise is a well-stocked mind, which comes from wide and judicious reading, and a facility of expression which is derived from practice—imitation, if necessary, of passages from good authors. Johnson advised those who wished to write good English to devote "days and nights" to the study of Addison. Robert Louis Stevenson admitted that he had learned much by assiduous copying. Ruskin said that it took him forty years to learn how to write, so that no student can expect to find a sudden awakening and power of expression. There is no secret method, but a steady and persistent climb.

Write one or two essays each week upon such subjects as—

(*a*) My favourite book.
(*b*) Newspapers.
(*c*) The different characters of children.
(*d*) "A bird in the hand is worth two in the bush."
(*e*) The English character.
(*f*) The Government of England.
(*g*) Christmas.
(*h*) Money.

Read up the subject if you are not well posted in it; no one can write an essay on a subject of which he knows nothing. Having obtained a sufficient stock of information, arrange your ideas under separate heads and sections to ensure a logical sequence and prevent diffusiveness and repetition, and then express your ideas in the best language at your command—avoiding a stilted, unnatural style, a striving after effect on the one hand and a too simple, childish, or colloquial style on the other. Revise the essay carefully and improve the balance and form of the sentences, read it aloud, and if necessary re-write it one or two times.

The following notes may assist in indicating how the subjects may be treated:—

(*a*) You are expected to adduce reasons why the book is a favourite—it is unnecessary to endeavour to epitomise its contents—there must (or should) be something in the information conveyed, in the characters, or in the plot which compels your admiration. Whatever it is must be indicated and justified.

(*b*) This subject may be treated historically (see the article in the *Harmsworth Encyclopædia*) or as a social and political force, or as institution of practical utility, from the commercial view and from the educational view. There should be no lack of ideas, but they will need careful sorting and arrangement.

(*c*) This is a rather more difficult subject, the facts for which must come largely from the experience you have had with classes or in the home. The variety of character is accounted for by heredity, by home circumstance, by state of health, etc. You cannot expect a puny and weak child to be energetic and happy, nor can you expect a healthy and happy child to sit still for any length of time. There is the dull child, the sensitive and shy child, the boisterous and bold child, the deceitful child — all to be educated and all to be treated differently.

(*d*) In writing an essay on any proverb, you might point out what a proverb is, then explain, if necessary, its literal sense, then the wider or more general sense. Although a proverb has been ably defined as "the wisdom of many and the wit of one," it does not always follow that the statement in a proverb is inevitably correct, in fact it is easy to find pairs of proverbs contradicting each other. The proverb above implies that it is better to have what we are sure of, than expect something which we are *not* sure of. Against this we may quote, "Nothing venture, nothing have." To be always content with the "bird in the hand" would cripple all enterprise and ambition.

(*e*) Read Emerson's Essays on this subject. English character can only be appreciated by comparison with the characteristics of other nations. To the voluble Frenchman we are taciturn and take our "pleasures sadly," to the grave Spaniard we are somewhat frivolous, to the philosophic men of the East with the doctrine of "Kismet" we are "mad." As a matter of fact the national character is on the whole one to be proud of. The love of freedom and of constitutional method derived from the Saxon, the love of the sea an inheritance of the Dane, the love of the beautiful a gift from the Norman French, make up a complexity of character which has made England the centre of the greatest empire the world has ever known.

(*f*) Little assistance is needed with this. Point out the three estates, their relation with each other, etc., and the advantages of a limited monarchy.

(*g*) Treat this any way you like, it is a subject full of interest. Many of the customs are derived from our pagan Anglo-Saxon forefathers, who rejoiced at the passing of the shortest day of a dreary winter, and many good old customs have been abolished by the spread of education.

(*h*) Take the following heads:—(*a*) Its convenience as a means of exchange as compared with barter; (*b*) its proper use; (*c*) its abuse.

Send up an essay each month for criticism and advice. The length should be from forty to fifty lines.

5. *Arithmetic.*—This subject has been simplified by the exclusion of most of the difficult rules, *e.g.*, Square and Cube Root, Ratio, Proportion, Stocks and Shares, Recurring Decimals, and Complicated Fractions. It is also stated that the questions will not involve long operations or complicated questions, and that answers to many sums will not be required beyond the nearest penny.

But though the syllabus is thus reduced, there will be an increased demand for the manipulation of numbers and intelligence in method. A test paper will be given each month on these lines.

For this month take the first four rules and the splitting up of numbers into prime factors. Use Christian and Collar's arithmetic. Note multiplication and division by factors, multiplying by the digits in any order, the value of partial products, proofs by casting out nines, etc.

6. *Drawing.*—Candidates will be tested in either (1) Freehand Drawing, or (2) Model Drawing, at the discretion of the examiner. This means that *both* subjects must be prepared. The drawings must be on such a scale as to fairly fill a half imperial sheet (*i.e.* 15″ by 22″); small drawings are quite useless. It is difficult to give much individual assistance in these columns. Students must send up their drawings for criticism. There are many excellent series of studies in photographs from the casts, and also good books on model drawing, but personal instruction is much better than either.

Each student should do one freehand copy and one set of models per week.

7. *Music—Staff Notation.*—All the major and minor scales and signatures, diatonic and chromatic intervals. The best book to use for this subject is Nelson's *Music for P.T.'s*. The scales and their order are easily remembered from the mnemonic GOOD ALE and BEEF. Read from left to right we have the scales with sharps G(1), D(2), A(3), E(4), B(5), F♯(6); from right to left the scales with flats F(1), B♭(2), E♭(3), A♭(4), D♭(6), G♭(6). The intervals are very easy if carefully studied for a short time. Always count in semitones, and remember the following table:—

Seconds	Minor contains	1	semitone.
	Major ,,	2	,,
Thirds	Minor ,,	3	,,
	Major ,,	4	,,
Fourths	Perfect ,,	5	,,
	Pluperf. or Aug.	6	,,
Fifths	Imperfect ,,	6	,,
	Perfect ,,	7	,,
Sixths	Minor ,,	8	,,
	Major ,,	9	,,
Sevenths	Minor ,,	10	,,
	Major ,,	11	,,
Octave	. . ,,	12	,,

The practical work should be regularly practised. Curwen's *Practical Music for P.T.'s* is an excellent little book. A few minutes' practice each day will soon cover all there is to be done.

OUR CERTIFICATE COURSE FOR 1906.

BY GEORGE COLLAR, B.A., B.SC.,

Head-Master of Stockwell Pupil-Teacher School.

Test Questions on Last Month's Work.

THEORY OF TEACHING.

1. What are the conditions that determine the dimensions of a class-room?

2. In what ways can the discipline of a school be affected by the school building?

3. What are the arguments in favour of teaching the metric system in elementary schools, and in which standards can it best be taught?

ENGLISH LITERATURE.

1. Give a summary of Mrs. Hutchinson's description of her husband.

2. Give an outline of the life of Colonel Hutchinson up to the time of his marriage.

ENGLISH HISTORY.

1. Give a short account of the origin, course, and results of the Crimean War.

2. Name the leading statesmen in the reign of Queen Victoria, and indicate their political work.

GEOGRAPHY.

1. Describe the chief means of communication in the United States.

2. Give an account of the chief mineral productions of the United States.

ARITHMETIC.

1. How many rectangular tiles, 4½ in. by 6 in., will be required to cover a floor 18 ft. long and 13 ft. 6 in. broad? And what will be the cost at 3s. 4d. a dozen tiles?

2. A rectangular tank is 10 ft. 6 in. long and 7 ft. 3 in. wide, and contains 400 gallons of water. Find the depth of the water, having given that a gallon contains 277¼ cubic inches.

3. What would be the cost of the material of a closed cubical box, 3 inches in thickness on all sides, whose interior is also cubical and contains 27 cubic feet, reckoned at 2s. 6d. per cubic foot of material?

Algebra.

1. In a geometrical progression of $2n$ terms and common ratio r, find the ratio of the sum of the odd terms to the sum of the even terms.

2. Prove that the sums of the two progressions—

$$1.\ \tfrac{4}{5},\ (\tfrac{4}{5})^2,\ (\tfrac{4}{5})^3 \ \ldots\ .$$
$$\tfrac{6}{5},\ \tfrac{7}{5},\ \tfrac{8}{5},\ \tfrac{9}{5^2}\ \ldots\ .$$

approach each other without limit as the number of terms is increased; and find at what place of decimals they differ when 32 terms are taken.

Geometry.

1. A certain polygon has seven sides, one of its angles is 25° greater than each of the others, which are equal; find the number of degrees in each angle. If the five sides which join vertices at which the angles are equal be each 1 inch, construct the polygon.

2. PQ is a chord of a circle. PA and QB are chords making equal angles APQ, BQP. Show, first, that if these angles are on the same side of PQ, then PA = QB, and, secondly, that if they are on opposite sides then the centre of the circle lies in the straight line which joins the middle points of PA and QB, produced if necessary.

Elementary Science.

1. What chemical differences distinguish arterial from venous blood, and what is the essential difference between the two?

2. How can it be shown experimentally that the proportions of oxygen and of carbonic acid contained in the blood really cause the difference in colour of arterial and of venous blood?

3. What causes the lungs of a dead animal to collapse when an opening is made into the chest, and what keeps them distended before the opening is made?

4. Describe what causes the air to enter and leave the lungs. What are the different types of breathing?

Notes and Syllabus for May.

English Composition.

Re-read the text-book on this subject.

Prepare essays on the following:—

1. "Trade follows the flag."
2. Political alliances.
3. Extravagance.
4. The essentials of poetry.

Theory of Teaching.

Study Chapter xiii. of Collar and Crook's *School Management*, and pay especial attention to the various papers bearing on Nature Study that appear in the *Practical Teacher*.

Last month, in the Elementary Science section, we dealt with the question of respiration, and what we have said then will make the question of ventilation so much the easier to discuss now. It is one of the most important of all questions that concern the healthiness of the schoolroom. It was shown last month that the quantity of carbon dioxide in the air that leaves the lungs is a hundred times as great as in the air that enters them; consequently, if a number of children are breathing in a confined space, the air will soon become too impure for further use. In fact, the air should never contain more than twice the normal amount of carbon dioxide; and if we consider 20 c. in. as the amount of tidal air, it follows that each person vitiates about 2000 c. in. at each breath. This is more than a cubic foot, but we may regard a cubic foot as the amount vitiated by a child at each respiration. Active children breathe about thirty times a minute; therefore each child requires 30 c. ft. per minute, or 1800 c. ft. of fresh air per hour as a minimum. If each child is allowed 250 ft. of air space, the air should be changed every ten or twelve minutes, and it should be supplied to the child at a temperature of not less than 60° F. If the temperature of the outside air is not lower than 50° F., the air may be freely admitted through open doors and windows; but when the outside temperature is lower than that, the natural currents of air must be supplemented by artificial means, either by heated flues which draw the air from the room and allow fresh air to enter by spaces provided, or else by fans which force air into the room and drive the vitiated air through outlets on the opposite side. The air supplied should be taken from outside, and not from the basement, or any place where it is contaminated by dust or bad smells; it should also be supplied with moisture.

It is not sufficient to admit air at one point and let it out at another; care must be taken that the fresh air circulates round the room. Experiments show that this is best effected by placing the inlet in the middle or upper part of the wall and the outlet near the floor on the same side. It is also advisable to have two or more outlets so as to avoid draughts. An open fireplace is a splendid means of ventilation, though one of the worst means of heating a large room; and although without a fire the chimney is of some use in ventilation, it is a good plan to put just a little fire in the grate to force a draught long before, and after, the weather makes a fire necessary for warming the room. Sometimes, when complicated systems are in use, no one seems to understand their working except the engineer who fixed them and the caretaker who attends to them, and the latter is often ignorant of the principles involved.

This should not be the case. The headmaster should understand the whole system, and each teacher should be familiar with the arrangements in his own room; in fact, he should give an occasional object lesson on them to the class. Whatever system is employed while the class is at work, the room must be thoroughly refreshed and purified each time it is empty by the sweep of free winds through all the windows widely opened. This should take place three or four times a day in all weathers, and a monitor should be appointed to open all the windows at recess time, when the class is in the playground, and during the midday interval.

The text-books give details of the various ways of heating schoolrooms, and the student must compare their advantages and disadvantages. In this respect it may be observed that one system may be inferior to another when considered solely as a means of heating, but yet may have advantages in the matter of ventilation which may make it preferable on the whole. We have pointed out that open fireplaces are not the most effective means of warming a room. They throw out heat to less than one-half the circle of which they are the centre, and a very large percentage of heat escapes up the chimney. On the other hand, one can see at a glance when they want replenishing; they look warm and bright, and they are valuable aids to ventilation. The direct radiation from closed stoves, or from steam or hot-water pipes, is objectionable, because it does nothing towards producing a supply of warmed, fresh air. If the ventilating inlet is behind the pipes, so that the air has to pass over them on entering, the objection is greatly diminished. The best method of heating schoolrooms is by indirect radiation, by which warmed air is drawn or driven into the room from chambers which are heated by coils of pipe. Rotatory fans may be connected with either the inlet or the outlet to the chamber; and if the steam used in working the fans is used to heat the coils, the cost is reduced to a very low point.

The question of lighting the school and class-room does not receive sufficient attention in this country, but in several countries on the Continent the ratio of window surface to floor surface is settled by law, and the minimum is fixed at 1 to 6 when the building stands quite alone, and at 1 to 4 when the light is obstructed by neighbouring buildings. In Prussia the minimum sanctioned is 1 to 5, and most people agree that this is the lowest ratio that should be allowed anywhere. As to the maximum, Dr. Cohn and other authorities say that there cannot be too much light in a schoolroom. In Germany, too, a standard of brightness is fixed for the dullest part of the room, which should be the same as that given by a 10 candle-light at one metre distance. The window arrangements should be such that every pupil can see some portion of the sky, and be able to read small print (diamond type) at a distance of a foot. No pupil should be seated more than 20 feet from a well-lighted window.

Authorities are not quite agreed as to the direction from which the light should enter the room; some urge that direct sunlight should never enter the room, and others advocate the use of windows facing south. Perhaps it is best to allow direct

sunlight to come into the room for a small portion of the morning or the afternoon. All are agreed that the pupils should never be seated so as to face the window, and also that it is objectionable to have light admitted from both the left and right. If the light comes from the right the pupil turns towards it when writing, and has to write in the shadow of his right hand. The best arrangement is to have the windows on the pupil's left, and these may be supplemented by windows behind, provided that these admit less light than the former.

Each window should consist of large panes, and reach well up to the top of the wall. Venetian blinds and dark curtains are objectionable, as they obstruct such a large amount of light. A brown holland blind is about the most suitable one that can be obtained, and on account of the superior effectiveness of the light from the upper part of the window, the blind should rise from the bottom, and not come down from the top. Black blinds may be used when it is desired occasionally to exclude all light, as, for instance, when using the magic lantern or giving a lesson on optics.

The light should always be diffused. If children write in direct sunlight, their eyes are tried by the sharpness of the shadows cast, and people who write by gaslight suffer in a similar way. The windows may therefore be glazed, particularly in the upper part, with ribbed or prismatic glass. It is claimed that on bright days such windows admit 50 per cent. more of effective light, and if the day be dull, the effective light is relatively more abundant still than on ordinary days. Diffusion of light is also brought about by having the walls distempered a light grey, cream, or green colour. A pale green does not perhaps reflect so much light as the other colours, but it is more restful to the eye. The lower part of the wall is not of much use in this respect, so a dark dado should be used, as this will not readily show the dirt, and if painted, it can be frequently washed.

In a very few English schools baths are to be found, but in some German and American towns the bath is as much a part of the school curriculum as geography or drill. Needless to say that all the reports speak very favourably of the benefits derived from the baths. An official book on Swedish education contains an interesting picture of the bathroom of a school, showing the children in baths all round the room, each one rubbing the scholar in the bath in front of him. Of course, a swimming-bath is more valuable from the point of view of exercise than from that of cleanliness, as it is considered that swimming employs more muscles than any other form of exercise.

English Literature.

Read through *Woodstock* again, and pay frequent attention to the poems in the *Golden Treasury*. The longer poems should be carefully analysed, and the shorter ones read at odd moments until they are known almost by heart.

English History.

Revise the earlier part of the outlines of the history, *e.g.* to 1485.

The following questions which were set in 1903 will suggest points for special attention:—

1. (*a*) What traces remain in Britain of the Roman occupation?

(*b*) Which of the following names are of Roman, Saxon, or Danish origin:—Nottingham, Lincoln, Whitby, Crossthwaite, Colchester, Edinburgh, Norwich? How do you know?

(*c*) State shortly what you know of Augustine, the Synod of Whitby, Theodore, Bede, and Dunstan.

2. (*a*) Describe the Feudal system as introduced by William the Conqueror.

(*b*) What dangers did this system present to the power of the Crown and to good order, and what steps were taken by William the Conqueror and Henry I. to lessen these dangers?

3. (*a*) What was the extent of the empire of Henry II., and at what periods were his various foreign possessions lost by England?

(*b*) State the questions at issue between Henry II. and Becket, and show how far they were solved by the Constitutions of Clarendon.

4. Give careful descriptions, illustrated by clear plans, of the battles of Hastings and Bannockburn.

5. (*a*) How did the French Wars of Edward III., the teaching of Wiclif, the Black Death, and the Statute of Labourers, severally lead to the Peasants' Revolt?

(*b*) How did an English army and a French army differ in the time of Edward III.? Explain the victories gained with very inferior numbers by him and by Henry V.

The following were set last year:—

1. Describe the part which Ireland played in the conversion of England to Christianity, and show how the rupture between the two Churches was caused.

2. Sketch the career of Dunstan, and his political and ecclesiastical policy.

3. How far can Alfred at the end of his reign be considered as King of all England? Trace the steps by which the kingdom was consolidated up to the reign of Edgar.

4. Describe the Courts for the administration of justice, and the arrangements for providing for national defence existing before the Conquest.

5. What measures were taken by William the Conqueror—(1) to prevent insurrections of the English; (2) to check and curtail the power of the Feudal Barons; (3) to preserve and utilise any existing institutions.

6. Give a brief account of the circumstances under which the following battles were fought, and show any important consequences that followed them:—Ethandune, Brunanburgh, Tenchebrai, Bouvines, Lewes.

7. Show that the later Parliaments of Edward I. were practically identical with those of the present day, and trace the steps by which they acquired that position.

8. Give an account of the Universities before the end of the thirteenth century, and of the coming of the Friars.

9. Give a consecutive, but not detailed, account of the Continental Wars of Edward III. up to the time of his death. Did these bring us into alliance or conflict with any powers besides France?

10. What do we know of the condition of the labouring classes in this and the following reign (presumably the reigns of Edward III. and Richard II.)? What pictures of the state of society do we get from any contemporary writers?

Geography.

Take the geography of Mexico and the West Indian Islands. Then revise the geography of Europe.

Arithmetic.

The following are questions recently set:—

1. *A merchant dilutes a cask of spirits with water and sells the mixture at the same price per gallon as he had paid for the undiluted spirit. If he made* 15 *per cent. profit on the transaction, find to three places of decimals the number of gallons of water in an* 18*-gallon cask of the mixture.*

The water is supposed to cost nothing, consequently the merchant buys 100 parts of spirit and adds 15 parts of water, in order to gain 15 per cent. Hence there are $\frac{15}{115}$ of 18 gallons of water in the cask.

$$\tfrac{15}{115} \text{ of } 18 \text{ galls.} = \tfrac{3}{23} \text{ of } 18 \text{ galls.} = 2{\cdot}348 \text{ galls.}$$

N.B.—The third figure is given as 8 since that is nearer the correct value than 7.

2. *Find the square root of* 893830612 *to two places of decimals, and raise* 2·01 *to the fourth power.*

Regard 2·01 as a binomial, and remember that

$$(a+b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4.$$

$$\text{then } (2+{\cdot}01)^4 = 16 + 4\times8\times{\cdot}01 + 6\times4\times{\cdot}0001 + 4\times2\times{\cdot}000001 + {\cdot}00000001.$$

$$= 16 + {\cdot}32 + {\cdot}0024 + {\cdot}000008 + {\cdot}00000001.$$

$$= 16{\cdot}32240801.$$

Since there are nine digits in the given number, and the square root has to be brought to two decimal places, there will be altogether seven digits in the result, but the last three will be obtained by simple division (see Text-Book, par. 302).

	893830612·0000(29891·40
49	493
588	5283
5969	57906
29889	418512·0000
	11961
	00052

Ans. 29891·40.

Algebra.

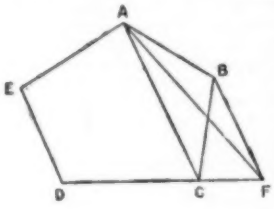
Study the Binomial Theorem for positive integral exponents, and the use of logarithmic tables.

Geometry.

Study the different cases of construction of a rectilineal figure to a specified scale or of specified area, and similar to a given figure. Construction of a square equal to a given polygon.

The great thing is to remember that similar figures are to one another as the squares of their homologous sides. Hence if it is required to construct a figure similar to a given figure and of twice the area we take a side of the given figure and draw a line $\sqrt{2}$ times as long. This, of course, would be the diagonal of the square of which the selected side of the given figure is the side. By a continued application of the principle of Euclid I., 47, a square may be found which is any number of times the area of a given square, and consequently if these sides be taken as the sides of similar figures, the figures will be to one another in the proportion of these squares.

The last proposition of the second book of Euclid can be employed for the construction of a square equal in area to a given polygon, but very few students employ the best method for finding a triangle or rectangle equal to a given polygon. Now a polygon of $n-1$ sides can always be found equal to a polygon of n sides by simply joining one angular point to the next but one, and drawing a line through the intermediate angle parallel to this line and cutting one of the adjacent sides produced. Thus if ABCDE is a five-sided figure, join AC and through B draw BF parallel to AC and cutting DC produced in F. Join AF. Then the triangle AFC = the triangle ABC; to each of these add the figure ACDE, then the four-sided figure AFDE = the five-sided figure ABCDE. By the repeated application of this plan any area can easily be reduced to a triangle.



Elementary Science.

Study the outlines of alimentation.

In its widest sense the term includes all those processes by which the animal's body is nourished. Even if we omit the prehension or seizure of food we must include—

(1) *Ingestion*, *i.e.* mastication and swallowing.

(2) *Digestion*, *i.e.* the dissolving of the solid food and making it capable of passing into the blood.

(3) ***Absorption and Assimilation***, the supply through the blood to the living tissues of the body.

(4) *Secretion and Excretion*, the separation from the blood of useful substances, or of waste matters.

(5) *Elimination of Waste Products.*

With regard to the food itself it may contain a great variety of chemical compounds, some of which are indigestible and non-nutritious; the others can be arranged in three groups—*proteids*, which contain nitrogen combined with oxygen, hydrogen, and carbon; *carbohydrates*, which contain carbon united with oxygen and hydrogen, in the proportion of two atoms of hydrogen to one of oxygen; and *fats*. A mixed diet is essential, and no animal can thrive if fed exclusively on one class of food.

Study the different ways by which various animals take their food and drink. This comparison will form a useful and interesting lesson to children.

Observe that invertebrates have no true jaws; they are frequently furnished with a pair of limbs in front of the mouth for crushing their food, but these work from the side to the middle and not up and down as the jaws of vertebrates do. Some fish, as the sturgeon, are toothless; others, as the shark and skate, have several rows in the front of the mouth, and as the front rows wear away or break off new ones grow behind them. Some fish have teeth on their tongue and palate, and even in their throat.

A peculiar arrangement of the jaw-bone enables reptiles and amphibians to open their mouths to an enormous extent. Poisonous snakes have a poison sac at the root of their fangs, which are hollow, and the seizure of prey causes the fang to press on this sac and squeeze out the venom, which runs down a little canal in the fang into the wound it has made. Certain tree-climbing serpents live on eggs, and have no teeth in the front of their mouth, as these would pierce the egg-shell and let the contents run out, but the whole egg is taken into the mouth and broken there by pressure against two teeth-like projections in the throat, when the contents of the egg pass down into the stomach. Frogs, toads, chameleons, and some other reptiles seize their food with the tongue, which is fixed in front, and when at rest has the lip pointing down the throat, but when catching an insect it is shot out to a great distance.

Birds have no teeth, but a horny beak, which is very hard and sharp in birds of prey, and also hard in birds that crush their food, but in water-birds it is generally soft and provided with a corrugated or fringed margin. The beak is a good index of the bird's habits.

In mammals there are invariably fleshy lips and a muscular sensitive tongue, which in some cases, *e.g.* cow and giraffe, serves to collect food previous to biting it off. The long tongue of the ant-eater serves to capture its insect prey. In the cat tribe the tongue is covered with little spines, which are useful in cleaning all traces of meat off bones. The ant-eater has no teeth, but crushes its prey against two hard ridges in its mouth. The adult whale has no teeth, but in the very young whale's jaws teeth are to be found, but they never cut the gums, and so the whale has no visible teeth throughout its life. The teeth of mammals are an index of their habits, and are used in classifying them. As we have said, ant-eaters have none, the narwhal has one tooth, but it is a longer tooth than any other animal can boast of; the dolphin, on the other hand, although related to the whale, which has no teeth, is supplied with no fewer than 220. In the higher mammals the teeth are arranged in distinct groups:—(i) *incisors*, or cutting teeth; rodents, such as the squirrel, have two highly developed incisors in each jaw, members of the cat tribe have six in each jaw, man has four in each jaw, the cow has none in the upper jaw, the elephant has none in the lower, and the sloth has none in either.

The *canine* teeth are so called because they form such a characteristic feature of the dog's dentition; they are of use in seizing and tearing food, and have longer roots, and, except in man, stand out beyond the others. They are absent in rodents and nearly all herbivorous animals. Next to these come *premolars*, which are preceded in the young by "milk-teeth"; next come the *molars*, which appear only in the "second set of teeth." These are generally flat but rough, and serve for grinding the food.

Teeth are composed of two substances, *dentine*, which resembles hard bone, and *enamel*, which are arranged in such a way as to make the tooth best serve the purpose it has to fulfil. Thus in rodents the incisor teeth have a plate of enamel in front backed by dentine, which prevents it from snapping off, but which is softer than the enamel, and so wears away and leaves a sharp edge of enamel. In the same way the molar of an elephant or horse is composed of alternate vertical layers of dentine and enamel, the former of which wears down and leaves the enamel in prominent ridges, thus keeping the surface of the tooth in a rough state suitable for grinding food.

French.

Translate the following:—

Travail et bonté.

Je suis né de deux êtres qui, après m'avoir donné la vie, m'ont élevé et m'ont fait homme. Si je regarde autour de moi, je vois qu'il en va de même pour tous les hommes, mes semblables.

Ce n'est pas tout. Nous tombons dans une société qui possède déjà une foule énorme de biens accumulés siècle à siècle. D'innombrables milliers de générations ont, depuis que le monde est monde, travaillé sans relâche à nous préparer une terre assainie, cultivée, parée de tous les dons d'une civilization plus riche, plus douce.

Eh bien! je me sens solidaire de toutes les générations qui m'ont précédé dans la vie et qui ont travaillé pour moi. Je ne puis rien pour leur témoigner ma reconnaissance et m'acquitter envers elles; sinon faire pour les hommes qui m'entourent, et ceux qui viendront après, ce qu'elles ont fait pour moi, donner ma part de travail, ajouter mon petit grain, faire en un mot le peu de bien dont je suis capable.

Notre premier devoir c'est le travail; notre second, c'est la bonté.

Nous devons être bons pour les autres, parce qu'on a été, si peu que ce soit, bon pour nous. C'est une simple conséquence de l'idée de solidarité. Maintenant, il est certain qu'il en est de la bonté comme du travail. L'exercice en est peut-être pénible au commencement; il devient un exercice et un jeu dont on ne pourrait se passer.

Je tâche de vivre le plus honnêtement que je puis en résumant la loi morale dans cette double formule: Travail et bonté.

Francisque Sarcey.

OUR SCIENCE SECTION

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NOTES ON PHYSICS.

BY EDWIN EDSER, A.R.C.SC.

Author of "Heat for Advanced Students," "Light for Students," "Differential and Integral Calculus for Beginners," etc.

General Physics.

Explain how the coefficient of shear elasticity (or the simple rigidity) of a substance in the form of a wire can be determined from an observation of the torque (or turning moment) which produces a given angular twist in the wire.

Let Fig. 1*a* represent a rectangular block of elastic material in its unstrained state. If the lower surface of this block is kept fixed, while the upper surface is displaced in its own plane, the block acquires the form shown in Fig. 1*b*. The volume of the block remains constant, but any two planes parallel to the upper surface are displaced relatively to each other, one sliding over the other. This displacement is called a *shearing strain*, or merely a *shear*. To produce this shear, a force (called the shearing force) must be applied tangentially to the upper plane parallel to the direction of its displacement; an equal but oppositely directed force must be applied tangentially to the lower plane in order to prevent this from moving. These two forces, of course, together constitute a couple.

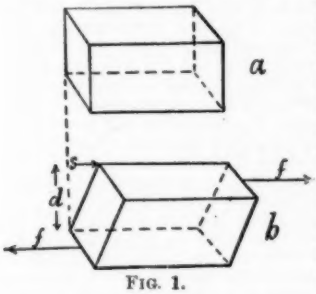


FIG. 1.

The displacement of the upper plane relatively to the fixed lower plane is defined as the shear s of the upper relatively to this lower plane. Experiment shows that, with a given block of elastic material, s is directly proportional to the tangential force f applied to the upper plane.

Experiments with different blocks of the same material show that, with a given shearing force f, the shear s is directly proportional to the perpendicular distance d between the upper and lower faces of the block, and is inversely proportional to the area a of the upper surface of the block. Hence, finally, we may write

$$s = \frac{1}{e} \cdot \frac{df}{a} \quad \ldots\ldots\ldots \quad (1)$$

where e is a constant for the given material, called the *co-efficient of shear elasticity*, or the *simple rigidity*, of the material. The quantity f/a, or the tangential force per unit area, is called the shearing stress. Since

$$e = \frac{f}{a} \cdot \frac{d}{s} = \frac{\frac{f}{a}}{\frac{s}{d}},$$

the co-efficient of shear elasticity e may be defined as the ratio of the shearing stress to the shearing strain produced between planes at unit distance apart.

Let Fig. 2 represent a cylinder of an elastic material. If the lower circular end of the cylinder is fixed, while two equal and opposite forces are applied at the ends of a diameter of the upper surface, each force being perpendicular to this diameter, then the upper surface will suffer a rotational displacement in its own plane. Let AB be a line drawn on the surface of the cylinder when unstrained, in a direction parallel to the axis of the cylinder. Then the application of the forces specified above causes the point A to rotate to A′, and the straight line AB becomes converted into the spiral line A′B. Any circular section of the cylinder is rotated without being itself deformed, its angular displacement being directly proportional to its distance from the fixed end of the cylinder. Let each of the applied forces be equal to F, and let the perpendicular distance between them be equal to D; then the *couple*, *turning moment*, or *torque* acting at the upper end of the cylinder is equal to FD, and for the cylinder to be in equilibrium, an equal but opposite torque must act at the fixed end of the cylinder.

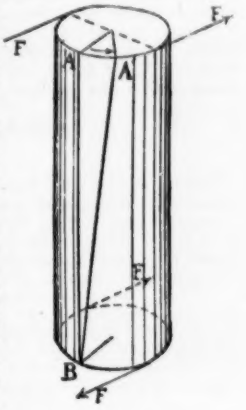


FIG. 2.

If we cut a thin slice from the cylinder by means of two imaginary planes perpendicular to the axis (Fig. 3), then the material above the slice must exert a torque on the upper surface equal to the applied torque, and the material below the slice must exert an equal but opposite torque on the lower surface.

Let L be the length of the cylinder. Let the torque FD acting at the upper end of the cylinder be represented by τ; and let the upper surface of the cylinder rotate through an angle θ when this torque is applied. The angle through which any other circular section will rotate is directly proportional to the distance of this section from the fixed end; thus, if the lower surface of the slice in Fig. 3 is at a distance x from the fixed end, while the upper surface is at a distance $(x+d)$ from the fixed end, these surfaces will rotate through angles

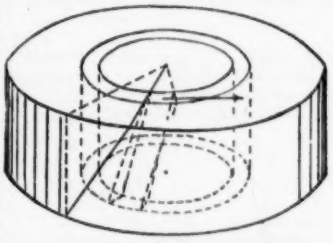


FIG. 3.

$$\frac{x}{L}\theta \text{ and } \frac{x+d}{L}\theta$$

respectively; hence the angular displacement of the upper surface of the slice, relative to the lower surface of the slice, is equal to $(\theta d/L)$.

About the axis of the slice (Fig. 3) describe two imaginary cylindrical surfaces with radii r_a and r_b, where $r_a < r_b$, and both these quantities are very nearly equal. These cylinders will cut off narrow annular strips from the upper and lower surfaces of the slice; and the rotation of the upper surface will displace each element of the upper annular strip relatively to the corresponding element of the lower strip through a definite distance. Hence it is clear that the substance enclosed between the two imaginary cylinders will undergo a shearing strain. If the radii of the cylinders are nearly equal, the displacement of the upper

relatively to the lower annular strip will be equal to $r \times (\theta d/L)$ where r is the average value of r_a and r_b; hence the shearing strain s of the material between the cylinders is equal to $(r\theta d/L)$. Each element of a strip will be acted on by a force perpendicular to the radius joining the element to the axis of the cylinder, and this force multiplied by the radius will give the corresponding element of the torque. Let the torque due to all the forces acting on the circular strip be equal to fr; then f can be found by substituting the proper values in (1), which gives us

$$f = \frac{cas}{d} = c\frac{a}{d} \cdot \frac{r\theta d}{L} = \frac{c\theta}{L} \cdot ar,$$

where a represents the area of the circular strip. Thus the element of torque supplied by the strip is equal to

$$fr = \frac{c\theta}{L} ar^2.$$

This result has been obtained on the assumption that r_a and r_b are so nearly equal that all points of the circular strip are at a uniform distance r from the axis. When the strip has a finite width, we must substitute for a the area of the strip (*i.e.*, $\pi(r_b^2 - r_a^2)$), and for r^2 the average value of the square of the distance from the axis (*i.e.*, $(r_a^2 + r_b^2)/2$). In this case

$$fr = \frac{c\theta}{L} \cdot \frac{\pi(r_b^2 - r_a^2)(r_b^2 + r_a^2)}{2} = \frac{c\theta}{2L}(r_b^4 - r_a^4).$$

Let us now divide the slice represented in Fig. 3 into a number of elements by means of imaginary cylinders of radii $r_0, r_1, r_2, r_3, r_4, \ldots r_n$, the value of r_0 being nearly equal to zero, while r_n is the external radius of the cylinder of elastic material. Then the circular surfaces of the slice will be divided into a number of strips by means of circles of radii $r_0, r_1, r_2, r_3, r_4 \ldots r_n$; let $f_1 r_1$ be the element of torque corresponding to the strip bounded by the circles of radii r_0 and r_1, while $f_2 r_2$, $f_3 r_3 \ldots f_n r_n$ represent the torques corresponding to the other circular strips. Then

$$f_1 r_1 = \frac{c\theta}{2L}(r_1^4 - r_0^4)$$

$$f_2 r_2 = \frac{c\theta}{2L}(r_2^4 - r_1^4)$$

$$f_3 r_3 = \frac{c\theta}{2L}(r_3^4 - r_2^4)$$

$$f_4 r_4 = \frac{c\theta}{2L}(r_4^4 - r_3^4)$$

$$\ldots = \ldots\ldots$$

$$\ldots = \ldots\ldots$$

$$f_{n-1} r_{n-1} = \frac{c\theta}{2L}(r_{n-1}^4 - r_{n-2}^4)$$

$$f_n r_n = \frac{c\theta}{2L}(r_n^4 - r_{n-1}^4)$$

On adding these equations together, the sum of $f_1 r_1, f_2 r_2, f_3 r_3 \ldots f_n r_n$ gives the total torque τ transmitted across the surface; hence

$$\tau = \frac{c\theta}{2L}(r_n^4 - r_0^4)$$

$$= \frac{c\theta r_n^4}{2L},$$

since r_0^4 will be infinitely small. Hence, finally

$$c = \frac{2L}{r_n^4} \cdot \frac{\tau}{\theta}.$$

Since θ will be proportional to τ, the ratio τ/θ will be constant for a given cylinder; this ratio represents the torque that will produce unit angular twist (*i.e.* the torque that will twist the free end of the cylinder through one radian), a quantity which can be determined experimentally by twisting one end of a wire through an observed angle by applying a known torque. If the radius r_n and the length L of the wire are now measured, the value of c can be calculated. It should be borne in mind that any error committed in measuring r_n will be quadrupled in our calculation, since r_n must be raised to the fourth power; consequently the greatest care should be exercised in measuring the radius of the wire, which can best be done (when the wire is thin) by weighing it in air and water on a chemical balance.

Heat.

Explain how to determine the ratio of the specific heats of air by Clement and Desormes' method.

Let OP, OV (Fig. 4) represent the axes of pressure and volume, and let the point A define the pressure and volume of a quantity of a perfect gas at a given temperature. Let the gas now be slightly compressed isothermally; its pressure will rise till it reaches the value indicated by the point B, if AB is part of the isothermal for the gas at the given temperature. During the compression heat is formed in the gas; and in order that the temperature of the gas may remain constant, the heat generated must be given out to external bodies as quickly as it is formed. Let the heat given out by the substance between A and B be returned to it at B while the volume of the gas is kept constant; then the temperature, and with it the pressure of the gas, will rise, the final condition of the gas being represented by the point C. If, starting at the point A, we had compressed the gas adiabatically (*i.e.* under such conditions that heat is neither conducted into nor out of it during the compression) we should have arrived at the point C; for the heat given out by the gas in passing from A to B along the isothermal was returned to it between B and C, with the result that along the path ABC the gas has neither gained nor lost heat by conduction. It follows that the adiabatic AC is steeper than the isothermal AB.

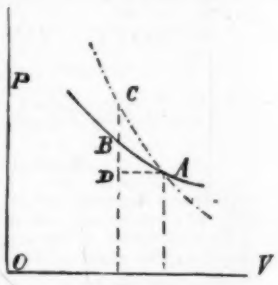


FIG. 4.

It will now be proved that the tangent to the angle of slope CAD of the adiabatic is γ times as great as the tangent to the angle of slope BAD of the isothermal, the line AD being parallel to the axis OV, and γ representing the ratio of the specific heats of the gas. In passing from A to D the pressure of the gas remains constant, while its volume diminishes by the amount AD; the diminution of volume is due to a fall of temperature at constant pressure, and if the temperature is $t°$ C. lower at D than at A an amount of heat equal to $ms_p t$ must be given out between A and D, s_p being the specific heat of the gas at constant pressure. In passing from D to B the temperature of the gas rises $t°$ C.; for A and B are on the same isothermal, and therefore if the temperature falls $t°$ in passing from A to D, it will rise $t°$ in passing from D to B. The volume of the gas remains constant from D to B; hence an amount of heat $ms_v t$, given to the gas at D, would suffice to raise its temperature through $t°$ and to bring it to the condition corresponding to the point B along the path DB, the specific heat of the gas at constant volume being denoted by the symbol s_v. On the other hand an amount of heat $m.s_p t$, given to the gas at D, would suffice to raise its temperature through $\frac{s_p}{s_v} \times t'$ at constant volume; and since, at constant volume, the rise of temperature is directly proportional to the rise of pressure, the final pressure of the gas would be that corresponding to the point C, where $DC = \frac{s_p}{s_v}$. DB.

Now $\tan CAD = DC/AD$, and $BAD = DB/AD$. Hence

$$\frac{\tan CAD}{\tan BAD} = \frac{DC}{DB} = \frac{s_p}{s_v} = \gamma.$$

In determining the ratio of the specific heats of air by Clement and Desorme's method, a quantity of air is compressed in a large vessel (the larger the better) and, when its temperature has had time to become equal to that of its surroundings, its pressure above the atmosphere is noted. The vessel is then for a moment put into communication with the atmosphere: part of the air is expelled, and that which remains in the vessel expands adiabatically till its pressure falls to that of the sur-

rounding atmosphere. The vessel must then again be closed. During the adiabatic expansion the temperature of the air in the vessel sinks below that of the atmosphere, and after the vessel has once more been closed the temperature of the contained air rises, and with it the pressure. The final pressure of the air above that of the atmosphere is noted. The data thus obtained suffice to determine the ratio of the specific heats of air.

It is well to use a manometer containing Fleuss oil, since by this means small variations of pressure can be measured with accuracy: when the pressure variations are small in comparison with the atmospheric pressure, arcs of isothermals approximate to straight lines and the calculation of γ becomes much simplified. The following investigation is carried out on the assumption that the pressure variations are small.

Let the point A (Fig. 5) represent the condition of that part of the air which remains in the vessel throughout the experiment, measured after the air has been compressed and has acquired the temperature of its surroundings; and let BA be the difference between the pressure of the contained air and the atmospheric pressure. On opening the mouth of the vessel the gas expands adiabatically to C, this point being at the same pressure as B. On closing the vessel the gas rises in temperature, with the result that the pressure rises to D, where A and D are on the same isothermal: then CD gives the final difference between the pressure of the gas and that of the surrounding atmosphere. Draw DE horizontally, cutting the constant volume line BA in the point E. Then, if the pressure variations were small, the arc AC of the adiabatic will approximate to a straight line, and tan ACB = BA/CB; the arc AD of the isothermal will also be approximately straight, and tan ADE = EA/ED = (BA − CD)/CB. Thus

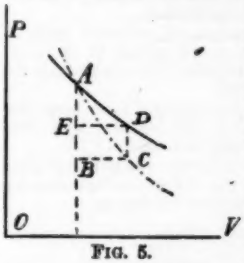


FIG. 5.

$$\gamma = \frac{\tan \text{ACB}}{\tan \text{ADE}} = \frac{\text{BA}}{\text{BA} - \text{CD}} = \frac{h_1}{h_1 - h_2}$$

where h_1 represents the original reading of the manometer, and h_2 represents the manometer reading after adiabatic expansion has occurred and the gas has finally acquired the temperature of its surroundings.

Light.

Draw a curve showing in the case of a convex lens the connection between the distance of the object from one principal focus and the distance of the image from the other.

University of London (External Students), Inter. Sci., 1903.

Definitions.—The position of a point object on the axis, which gives rise to an image at infinity (the transmitted rays being then parallel) is defined as the *first principal focus* of the lens. In the following the first principal focus will be denoted by F_1. When the incident rays are parallel to the axis the position of the image is defined as the *second principal focus* of the lens. In the following the second principal focus will be denoted by F_2. The distance from the lens to F_2 is called the focal length of the lens; this will be denoted by f. The distance from F_1 to the object will be denoted by U; the distance from F_2 to the image will be denoted by V. When numerical values are to be substituted for U, V, and f, the following convention as to signs is used. Distances measured in the direction of the incident rays are given negative (−) signs; those measured in the opposite direction are given positive (+) signs.

When a ray passes through a lens its direction is generally altered. The following laws are strictly true only for a thin lens, *i.e.* a lens which is so thin that f may be measured from either side of the glass without making any appreciable difference in the value obtained. In this case, provided that we make the transmitted ray intersect the axis at the proper point, we may draw the ray as if it were deflected at a plane instead of at the lens: this plane, which is drawn perpendicular to the axis at the point where the latter passes through the lens, is called the *principal plane* of the lens. The two foci lie at equal distances on opposite sides of the principal plane, F_1 being on the positive and F_2 on the negative side when the lens is convex.

In Fig. 6 let the line drawn through A perpendicular to the axis represent the principal plane of a convex lens, F_1 and F_2 being the first and second principal foci. Let OB represent a real object placed to the right of the lens, so that the positive direction is from left to right. Then

$$\text{Distance from } F_1 \text{ to } O = F_1O = U.$$
$$\text{Distance from A to } F_2 = AF_2 = f.$$

(When substituting numerical values, U will be positive for the position of the object represented, while f will have a negative value.)

Distance from O to B = OB = o (say). This gives the size of the object. When a distance is measured from the axis in an upward direction (as O, Fig. 6) a positive sign must be prefixed to its numerical value when this is substituted. When a distance is measured downwards from the axis a negative sign must be prefixed to its numerical value when this is substituted.

From B, the top of the object, draw the line BC parallel to the axis; this represents an incident ray from B. At the point C, where this ray cuts the principal plane, the corresponding transmitted ray CF_2 originates; we know where this transmitted

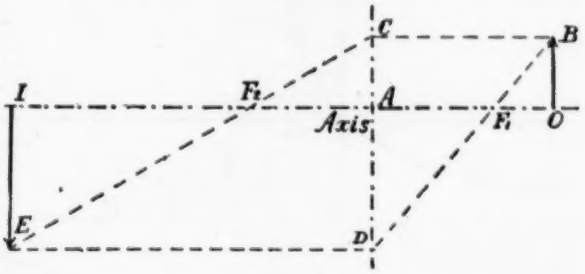


FIG. 6.

ray cuts the axis, since rays initially parallel to the axis give rise to transmitted rays which cut the axes in F_2. Draw the line BF_1 cutting the principal plane in D; this represents another ray from B, and since this ray passes through F_1 it must give rise to a transmitted ray DE parallel to the axis.

Let CF_2 produced cut DE in E; then the diverging cone of rays from B, bounded by the rays BC and BD, give rise to a converging cone of transmitted rays bounded by CE and DE, all of which pass through E and then diverge. Consequently E is the image corresponding to the point B of the object. Draw EI perpendicular to the axis, cutting the latter in I; the IE is the image corresponding to the object OB. Let the distance from the axis to E be denoted by i, which gives the size of the image; or substituting a numerical value for i, the convention as to signs already defined must be adhered to.

Distance from F_2 to I = F_2I = V.

The magnification m is defined as the ratio i/o. When this ratio has a positive numerical value, the image lies on the same side of the axis as the object, and *vice versâ*. The two triangles BF_1O and DF_1A are similar, since both are right-angled triangles, and $\angle BF_1O = \angle DF_1A$.

Hence
$$\frac{\text{OB}}{\text{F}_1\text{O}} = \frac{\text{AD}}{\text{F}_1\text{A}}.$$

Notice that since F_1O is measured from F_1 to O, we must measure F_1A from F_1 to A, in order to obtain complete similarity of treatment. Further, $F_1O = U$, and $F_1A = AF_2 = f$, since F_1A and AF_2 are numerically equal distances measured in the same direction. Then, since OB = o, and AD = IE = i, we have

$$\frac{o}{\text{U}} = \frac{i}{f}.$$

$$\therefore\ m = \frac{i}{o} = \frac{f}{\text{U}}. \quad . \quad . \quad . \quad . \quad (1)$$

The triangles EF_2I and CF_2A are also similar; thus

$$\frac{\text{IE}}{\text{F}_2\text{I}} = \frac{\text{AC}}{\text{F}_2\text{A}} = -\frac{\text{OB}}{\text{AF}_2}.$$

$$\therefore\ \frac{i}{\text{V}} = \frac{o}{-f}.$$

$$\therefore\ m = \frac{i}{o} = -\frac{\text{V}}{f}. \quad . \quad . \quad . \quad (2)$$

The equations (1) and (2) give two values for the magnification, and since these two values must be equal, we have

$$\frac{f}{U} = -\frac{V}{f}.$$

$$\therefore\ UV = -f^2,$$

which is the equation connecting the distance (U) of the object measured from F_1 with the distance V of the image measured from F_2. Since f^2 must be positive, $(-f^2)$ must be negative; thus when U is (+) V is (−), and *vice versâ*.

We can now draw curves showing the relation between U and V; the same curves may be used to exhibit the relation between the distance *u from the lens* to the object, and the distance *v from the lens* to the image. Let L (Fig. 7) represent the point where the lens is cut by the axis; let *u* be measured from L to the right when (+) and to the left when (−), and let

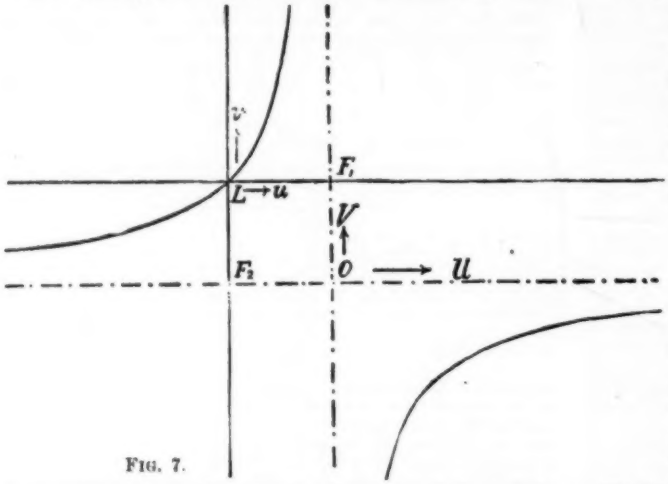


FIG. 7.

v be measured from L upwards when (+) and downwards when (−). U is measured from F_1, a point on the positive side of the lens, while V is measured from F_2, a point on the negative side of the lens. Hence if we draw new axes through F_1 and F_2, as in Fig. 7, their point of intersection will give us a new origin O, from which U must be measured to the right when (+) and to the left when (−), V being also measured from O upwards when (+) and downwards when (−). The equation

$$UV = -f^2,$$

which connects U and V, represents the two rectangular hyperbolas drawn in Fig. 7.

EXERCISES.

(1) Obtain the equation

$$UV = -f^2,$$

for a convex lens, using the method described above, but drawing the object between F_1 and the lens in Fig. 6.

(2) Show that the equation

$$UV = -f^2$$

also applies to a concave lens. Draw the corresponding curves. (Note that F_2 is on the positive and F_1 on the negative side of a concave lens.)

(3) Draw curves showing the relation between *u* and U, (*a*) for a convex, and (*b*) for a concave lens.

(4) Draw curves showing the relation between *u* and V, (*a*) for a convex, and (*b*) for a concave lens.

(5) Using a method similar to that worked out above, prove that if U is the distance from the focus of a *mirror* to the object, and V is the distance from the focus to the corresponding image, then $UV = +f^2$.

Draw the curves representing this relation.

(6) In the case of a mirror, find the values of U and V in terms of *u*, *v*, and *f*. Hence, substituting in the equation given in exercise (5), prove that

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}.$$

(7) In the case of a lens, find the values of U and V in terms of *u*, *v*, and *f*. Hence, substituting in the equation $UV = -f^2$, prove that

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}.$$

MATHEMATICS.

(STAGES 2 AND 3.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mathematics, etc., Morley College; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Solution of Triangles.—In solving triangles to the degree of accuracy obtainable by seven-figure logarithms, much time will be wasted, and the liability to error increased, unless the student exercises care in the arrangement of his work. The following hints may be of use in this matter:—

(*a*) State clearly the formulæ to be used; this will of course follow from the given data.

(*b*) Arrange the logarithms in columns (not in rows), those which have to be added in one row, and those subtracted in another; in this manner the work can easily be checked.

(*c*) When the angles of a triangle have been calculated from the given data, add together, and make sure that the sum of the angles is 180°.

(*d*) It is not advisable to write down unnecessary figures. Thus, to find the difference between log 7·1068 and log 7·1067. This is written as

$$\begin{aligned} \log 7{\cdot}1068 &= 8516741 \\ 7 &= \quad 680 \\ \text{Diff.} &= \quad 61 \end{aligned}$$

(*e*) As far as possible all subordinate calculations for differences of seconds, etc., must be kept out of the main work by putting them in a margin.

(*f*) See that the final results agree with regard to magnitude, *i.e.* the greater angle opposite the greater side, etc.

The remaining elements or parts of a triangle may be found when the data include: (*a*) *Two angles and a side*; (*b*) *The three sides*; (*c*) *Two sides and an angle.*

The sine formulæ.—In the usual manner *a*, *b*, *c*, are taken to denote the sides of a triangle subtended by the angles A, B, C respectively; then

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.$$

Thus in the acute-angled triangle ABC

$$AD = c \sin B = b \sin C;$$

$$\therefore\ \frac{b}{\sin B} = \frac{c}{\sin C}.$$

Similarly, by drawing a line from C perpendicular to AB, we obtain

$$\frac{a}{\sin A} = \frac{b}{\sin B}.$$

Hence

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \quad . \quad . \quad . \quad . \quad (1)$$

The preceding and the following formulæ are given in all books on Trigonometry; each should be carefully made out.

$$a^2 = b^2 + c^2 - 2bc \cos A \quad . \quad . \quad . \quad . \quad (2)$$

$$\tan \tfrac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} \quad . \quad . \quad . \quad (3)$$

The reader should test the accuracy of his information by writing out the formulæ (1), (2), and (3), and afterwards proceeding (without the help of a text-book) to fill in the proofs. Another important matter is to carefully note the cyclical arrangement of the letters; thus, for example, the two remaining forms of (2) are

$$b^2 = a^2 + c^2 - 2ac \cos B,$$

$$c^2 = a^2 + b^2 - 2ab \cos C.$$

The formula for $\tan \frac{1}{2} A$ may be found from

$$\sin \tfrac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}},$$

and

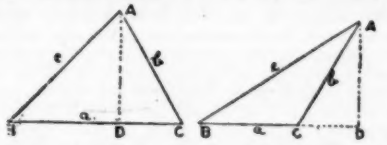
$$\cos \tfrac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}.$$

Similarly

$$\tan \tfrac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{s(s-b)}}, \text{ etc.}$$

Another formula frequently required is $a=b\cos C+c\cos B$; the proof of this may be obtained as in the following example:—

Ex. 1. In any triangle ABC show that $a=b\cos C+c\cos B$



(i) when both B and C are acute angles, (ii) when C is an obtuse angle; (iii) hence show that $\sin A=\sin B\cos C+\sin C\cos B$. (1901)

(i) Referring to figure, $DC=AC\cos C=b\cos C$

and $DB=AB\cos B=c\cos B$.

$\therefore DC+DB=b\cos C+c\cos B$,

$\therefore a=b\cos C+c\cos B$.

(ii) $DC=AC\cos(180°-C)=-b\cos C$,

$DB=AB\cos B$;

$\therefore DB-DC=c\cos B+b\cos C$,

or $a=b\cos C+c\cos B$.

(iii) Dividing by a we obtain

$$1=\frac{b}{a}\cos C+\frac{c}{a}\cos B,$$

$$\text{or } \frac{\sin B}{\sin A}\cos C+\frac{\sin C}{\sin A}\cos B=1;$$

$\therefore \sin A=\sin B\cos C+\sin C\cos B$.

Ex. 2. The hypotenuse of a right-angled triangle is 1000 feet long, and the difference between the other two sides is 240 feet; calculate the other sides and angles of the triangle, and verify your result by drawing the triangle to scale. (1903)

Let C be the right angle, the perpendicular be x, then the base is $240+x$.

$$\therefore (240+x)^2+x^2=(1000)^2,$$

$$\text{or } 2x^2+480x+57600=1000000;$$

$$\therefore x=576{\cdot}85$$

$$\sin B=\frac{x}{1000}=\frac{576{\cdot}85}{1000};$$

$$\text{L sin B}=\log 576{\cdot}85-\log 1000+10=9{\cdot}7610629$$

$$\underline{\qquad\qquad 09274}$$

$$\underline{\qquad\qquad 1355}$$

$$\text{L sin } 35°\ 14'=9{\cdot}7611063$$

$$\text{,, } 13'=\underline{\qquad 09274} \qquad \therefore \frac{1355\times 60}{1789}=45$$

$$\text{Diff. for } 60''=\underline{\qquad 1789}$$

Hence $C=90°$,

$B=35°\ 13'\ 45''$,

and $A=54°\ 46'\ 15''$.

Ex. 3. Establish the formula

$$\left(\sin\frac{A}{2}\right)^2=\frac{(s-b)(s-c)}{bc}$$

and by means of it find the greatest angle of the triangle whose sides are 13 feet, 30 feet, and 37 feet long respectively. (1905)

The greatest angle A will be the angle opposite the greater side.

$a=37$ $\quad s=40$

$b=10$ $\quad s-b=10$

$c=13$ $\quad s-c=27$

$2s=60$

$$\therefore \sin\frac{A}{2}=\sqrt{\frac{10\times 27}{30\times 13}}$$

$$=\frac{3}{\sqrt{13}}$$

$$\text{L sin A}=\log 3-\tfrac{1}{2}\log 13+10$$

$$=10{\cdot}4771213-\tfrac{1}{2}(1{\cdot}1139434)$$

$$=9{\cdot}9201496$$

$$\text{L sin } 56°\ 19'=9{\cdot}9201836 \qquad 9{\cdot}9201496$$

$$\text{,, } 18'=\underline{\qquad 0994} \qquad \underline{\qquad 0994}$$

$$\text{Diff. for } 60''=\underline{\qquad 842} \qquad \underline{\qquad 502}$$

$$\therefore \frac{502\times 60}{842}=35{\cdot}8.$$

$$\text{Hence } \frac{A}{2}=56°\ 18'\ 35''{\cdot}8;$$

$$\therefore A=112°\ 37'\ 11''{\cdot}6.$$

Ex. 4. In any triangle, ABC, show that

(a) $a=b\cos C+c\cos B$.

(b) $\dfrac{b}{\tan B}=\dfrac{a-c\cos C\sin B}{\sin C}$.

(c) $a^2+b^2=c^2+2ab\cos C$. (1898)

Ex. 5. Find an expression for the sine of half an angle (A) in terms of the sides of a triangle ABC.

If the sides are 7, 10, and 13 respectively, find (a) the sine of half the largest angle, (b) the largest angle true to the nearest second. (1898)

Ans. $\dfrac{2}{\sqrt{7}}$; $98°\ 12'\ 48''$.

Ex. 6. Show that in any plane triangle the sides are proportional to the sides of the opposite angles. (*N.B.* Two cases are to be considered.)

ABC is a right-angled triangle, and the line bisecting the right angle C cuts AB in D; show that

$$DB=AD\tan A. \qquad (1903)$$

Ex. 7. Prove the formula

$$\sin\frac{A}{2}=\sqrt{\frac{(s-b)(s-c)}{bc}}.$$

The sides of a triangle are 58125, 46571, and 37604; find, by means of the formula above, the largest angle of the triangle.

Ans. $86°\ 39'\ 15''{\cdot}6$. (1900)

Ex. 8. The sides of a triangle are 7, 10, 13 units respectively; find the smallest angle of the triangle. (1902)

Ans. $32°\ 12'\ 15''$.

Ex. 9. A horizontal line is 1000 yards long, and runs from east to west; from the eastern end, the summit of a hill bears $3°\ 25'$ E. of N., and is at an altitude of $41°\ 48'$; from the other end it bears $45°\ 25'$ E. of N. Find, to the nearest foot, the vertical height of the summit above the points of observation.

Ans. 2814 ft. (1902)

PHYSIOGRAPHY.

(STAGES 2 AND 3.)

HYGROMETRY—(*continued*).

Dine's Hygrometer.—In Dine's hygrometer, shown in Fig. 3, the cooling is produced by cold water. The apparatus consists essentially of the following parts:—

A vessel A to contain water and ice or cold water alone, a pipe leading from A to a shallow rectangular box E, and an exit

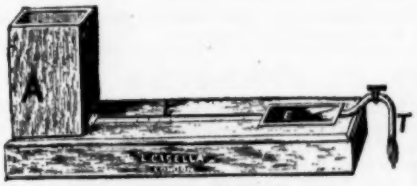


Fig. 3.

tube T. The top of the box E is made of a sheet of silver or of black glass. A thermometer t is placed with its bulb inside the box E. Inside the box E is also a partition which causes the cold water to spread itself over the bulb of the thermometer and over the silver or black glass lid.

A stop-cock is also provided on the tube leading from A to E, or on the exit tube T, to regulate the flow of cold water from A.

When a determination of the hygrometric state of the air is to be made, the temperature of the air is read by means of the thermometer before the cold water is introduced into A. Cold water or ice and water are then introduced into A, and the stop-cock turned to allow water to flow into E. This cools the black glass top, and this in turn cools the air in contact with it. When the air is cooled down to the temperature of the dew-point, dew is deposited on the glass, rendering the surface dull.

The reading of the thermometer is then taken. As soon as the dew is observed, the stop-cock is turned off and the temperature allowed to rise.

The dew gradually evaporates, and the temperature at which it disappears is noted. The mean of the two readings gives the dew-point approximately.

A second determination is now made more carefully by allowing the water to flow through *very slowly* as the dew-point is reached. The temperature of the dew-point and the temperature of the air having been determined, the relative humidity is calculated in the usual way by means of the ratio—

$$\frac{\text{Moisture required for saturation at dew-point.}}{\text{Moisture required for saturation at observed temperature.}}$$

Mason's Wet and Dry Bulb Hygrometer.—This hygrometer, which is shown in Fig. 4, has to a very large extent replaced other hygrometers for determining the amount of moisture in the air. It consists of two exactly similar thermometers, placed at a short distance from each other. The bulb of one is covered by a piece of thin muslin, which is kept moist by means of a piece of cotton lamp wick attached to it and dipping into a small vessel of water. Capillarity causes water to rise to the muslin. The water gradually evaporates, and in doing so cools the bulb of the thermometer. The extent of the cooling depends upon the rate of evaporation, and this in turn depends upon the hygrometric state of the air. When the air is very moist little evaporation takes place, and the two thermometers give almost identical readings. When the air is dry, however, evaporation takes place readily, and as the water vaporises it takes up its latent heat and cools the thermometer below the temperature of the air. When the temperature of the thermometer is stationary, the thermometer is receiving as much heat from the air as it is losing owing to the evaporation. In order to get the maximum cooling effect the hygrometer should be placed in a draught or gentle wind, so that the air which is in contact with the muslin and becomes saturated, may be continually removed.

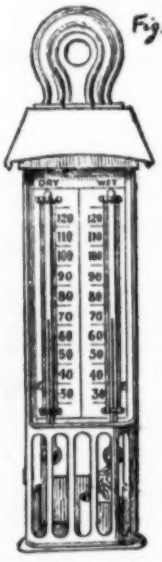


Fig. 4.

When the temperature of the air is below freezing-point water does not ascend through the wick, and then when it is required to make a determination the bulb must be dipped in water and the water adhering allowed to freeze. Evaporation then takes place from the surface of the ice, and after a little time a reading may be taken.

The relation between the readings of the two thermometers and the humidity of the air is not yet *fully* understood, but an approximate formula has been worked out by Dr. Apjohn, and this may be expressed as follows:—

$$F = f' - \frac{t - t'}{87} \cdot \frac{A}{30}$$

where t is the temperature Fahrenheit as read on the dry thermometer and t' the temperature on the wet bulb thermometer, A is the height of the barometer in inches, f' the maximum vapour pressure of water at the temperature of the wet bulb, and F the maximum vapour pressure at the dew-point.

In an observation we read A, t, and t', take f' corresponding to t' from the tables and thus calculate F.

The dew-point then becomes known, and the relative humidity is also determined by the ratio $\frac{F}{f'}$.

If the temperature is below freezing-point the formula used is

$$F = f' - \frac{t - t'}{96} \cdot \frac{A}{30}.$$

Dr. Apjohn's formula, however, is not very largely used, as a set of tables has been drawn up by Mr. Glaisher. These tables are known as Glaisher's Tables, and were drawn up by a comparison of simultaneous readings taken with Mason's hygrometer and Daniell's hygrometer during a number of years at Greenwich Observatory and also in India and Toronto. Glaisher's Tables show that the difference between the temperatures of the dew-point and the wet bulb bears a constant ratio to the difference between the readings of the two thermometers for any given temperature of the dry bulb.

When the temperature of the dry bulb is 53° F., the difference between the readings of the two thermometers is equal to the difference between the temperatures of the wet bulb and the dew-point. When the temperature is higher, the temperature of the wet bulb is further from the temperature of the air than from the dew-point, and at lower temperatures the reverse is the case. When the air is still, and also when it is very dry, the relative humidity as deduced from Mason's hygrometer is generally too high. This is probably due to the temperature of the wet bulb being too high owing to the heat which it receives by radiation from surrounding bodies.

CHEMISTRY.

(ADVANCED AND HONOURS.)

BY C. A. WEST, B.SC., A.R.C.S., F.I.C.

Vessels of Fused Silica and of Glass.—In view of the use of vessels of fused quartz or silica in the laboratory, the following information will be of interest:—

Quartz vessels are not acted on by water at temperatures up to 100° C., the electrical conductivity remaining unaltered. The action of various alkalis has been examined. Barium silicate is formed to a small extent by the action of baryta water in the absence of air on a quartz vessel, maintained at 18° C. for six months. Dilute acids, with the exception of hydrofluoric acid, do not appreciably attack quartz vessels at temperatures up to 100° C. Concentrated sulphuric acid at 18° C. and at 100° C. has no appreciable action. Phosphoric acid at 400° C. has a strong corroding action. The quartz vessels absorb certain dyes from their solutions.

The use of quartz vessels is recommended for physical or analytical work where neutral or aqueous acid solutions are dealt with.

M. Berthelot has conducted a series of experiments which show that vessels of silica are permeable to oxygen, nitrogen, and hydrogen, at a temperature of 1300° C. In one such experiment, a tube of 4 c.c. capacity was filled with pure oxygen at a pressure of half an atmosphere, the tube being then sealed and heated at 1300° C. for an hour and a half. After cooling, the tube was found to contain 3 c.c. of nitrogen. Another tube of 5 c.c. internal volume was filled with hydrogen at a pressure of one-fifth of an atmosphere and heated at 1300° C. for one hour. The gas extracted from the tube after the experiment consisted of 0·68 c.c. of hydrogen and 0·12 c.c. of nitrogen, measured at atmospheric pressure. A considerable amount of hydrogen has thus escaped from the tube, the original volume measured at atmospheric pressure being equal to 1·0 c.c. When naphthalene was heated in an exhausted fused silica tube at 1300° C., carbon was deposited, and the hydrogen escaped almost completely through the walls of the tube.

The volume of gas contained in the tube after heating for one hour at 1300° C. was only 0·18 c.c. (instead of 14 c.c., if all the hydrogen in the naphthalene had been liberated and retained), and analysis showed this to consist of 0·15 c.c. of hydrogen and 0·03 c.c. of nitrogen.

Phenomena of the same nature were observed when methane was heated in a fused silica tube.

Berthelot also finds that tubes of "ordinary" white glass, or of Jena glass, are permeable to hydrogen, oxygen, and carbon monoxide under the conditions observed for fused silica vessels, but at lower temperatures. No loss was observed when wood charcoal or graphite was heated in either "ordinary" or Jena glass vessels, otherwise vacuous. The permeability of the walls of glass, or fused silica vessels, to gases is regarded as similar in character to the interchange of gases which takes place through caoutchouc or animal membranes.

Atomic Weights and Molecular Weights.—In the *Comptes Rendues*, Philippe A. Guye gives the calculation of the exact molecular weights of the easily liquefiable gases from their densities, and the atomic weights of hydrogen, nitrogen, argon, chlorine, sulphur, and carbon.

The relationship $M/L\,(1+a)(1-b) = 22{\cdot}412$, in which M is the molecular weight, L the weight of a litre of the gas in the normal state, and a and b the constants calculated from the critical data, is not satisfied by the more easily condensible

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gases. The deviations are due to the fact that the values of a and b for the critical state differ from the values for the normal condition. The correct values for the normal condition of the gas have been deduced, and the following molecular weights, referred to $O_2=32{\cdot}000$ as basis, have been calculated: CO_2, 44·003; N_2O, 44·000; SO_2, 64·065; HCl, 36·484; C_2H_2, 26·018. From these, the atomic weights of the contained elements are deduced.

The numbers given are: hydrogen, 1·0077; carbon, 12·002; nitrogen, 14·007; chlorine, 35·476; sulphur, 32·065; and argon, 39·866. Except in the case of nitrogen, these values agree well with the numbers in the international table.

With regard to nitrogen, the atomic weight may be deduced from the ratio of the densities of nitrogen and oxygen. If d_1 and d_2 are the densities of two gases measured at corresponding temperatures T_1 and T_2, and under corresponding pressures p_1 and p_2, and if the molecular weights of the gases are M_1 and M_2, then, according to the theory of corresponding states, $d_1/d_2 = M_1p_1T_2/M_2p_2T_1$, or $M_1/M_2=(d_1T_1/p_1)/(d_2T_2/p_2)$. The ratio of the densities of the two gases, measured at corresponding temperatures and pressures, when reduced to the normal state (0° and 760 mm.), should therefore give the ratio of the molecular or atomic weights.

When the corresponding temperatures and pressures are so chosen that the interpolation involved in the reduction is a minimum (oxygen, 100° and 760 mm.; nitrogen, 37° and 505 mm.), the number deduced for the atomic weight of nitrogen is 14·014.

According to Berthelot, the two gases satisfy the simple laws with greatest exactitude at a temperature equal to 2·45 × critical temperature. If these (oxygen, 105°; nitrogen, 40°) are taken as the corresponding temperatures, and the pressure in each case is taken as 760 mm., the atomic weight deduced is 14·011. These numbers are compared with others obtained from density measurements, by using other reduction methods, and 14·009 is considered to be the most probable value of the atomic weight of nitrogen according to density determinations.

Action of Liquid Air on the Life of Seeds.—The power of resistance of seeds towards low temperatures depends only on the amounts of water and gas present in their tissues. When a certain quantity of gas and water is present, the cold disorganises the protoplasm and the nucleus. If, however, the protoplasm has reached its maximum of concentration by drying, it completely escapes the action of low temperatures and does not freeze. The seed then retains its germinating power.

Action on the Soil of the Mineral Constituents of Plant Residues Soluble in Water.—A series of experiments have been carried out to determine the action of plant residues lying on soil. It was found that water percolating through leaves extracted considerable portions of the potassium, magnesium, sulphuric acid, and phosphoric acid, but very little of the calcium and silica. A good deal of the iron was also extracted.

When the water which had already percolated through leaves was allowed to percolate through soil, 58 per cent. of the potassium, 69 per cent. of the phosphoric acid, and 38 per cent. of the magnesium removed from the leaves was retained by the soil. On the other hand, the amounts of calcium and sulphuric acid showed a further increase after the water had percolated through the soil, owing to the substitution of bases and to the action of the organic acids previously extracted from the leaves. The soil did not absorb appreciable amounts of sodium, iron, manganese, or silica.

Carbon Monoxide in Soils.—The carbon monoxide in soils is produced in the respiration of bacteria, moulds, algæ, and the roots of plants. In some recent experiments the amount produced by microbes in 1 kilo. of arable soil (to a depth of 40 cm.) in 24 hours, was from 17 to 50 mg. If only 15 mg. of carbon dioxide were produced in that time, the amount per hectare per annum would be 1400 kilos. when only 200 days of the year, on which an average temperature of 15° is reached, are counted. In the case of forest soil, the amount may be four times as great. As regards the production of carbon by roots, 2,000,000 cereal plants (the minimal number per hectare) give off 60 kilos. per diem. Of the different plants included in the experiments, *Trifolium pratense*, *Beta vulgaris*, and *Avena sativa*, produced the greatest amounts. The action of roots, especially young roots, on the mineral substance of the soil is due to the carbon dioxide of the roots and not to organic acids, which are not secreted by roots.

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The Editor reserves to himself the right to decline to answer any question which is, in his judgment, unsuited to the Magazine.

H. J. E.—A gives B 30 yards start in a race which lasts 3¼ minutes; he passes B 320 yards from the winning post and wins by 7½ yards.

Find the length of the course and the rate of each (supposed uniform) in feet per second.

(*A New Arithmetic*, by Christian and Collar.)

While A covers the last 320 yards of the course, B covers $(320-7\frac{1}{2})$ yards. The rates of A and B are therefore as $320:312\frac{1}{2}$, that is, as 128 : 125.

Hence to gain 3 yards on B, A must cover 128 yards. Therefore to gain 30 yards on B, A must cover 1280 yards. But A runs 320 yards after he has gained 30 yards on B. The length of the course is therefore (1280 + 320) yards, that is, 1600 yards. Since A covers (1600×3) feet in $(3\frac{1}{4}\times60)$ seconds, his rate is $\frac{1600\times3}{3\frac{1}{4}\times60}$ feet per second, that is, $\frac{1600\times3\times4}{15\times60}$ feet per second, that is, 21⅓ feet per second. But B's rate is $\frac{125}{128}$ of A's rate, and is therefore $\frac{125}{128}\times\frac{64}{3}$ feet per second, that is, 20¾ feet per second.

Scamp.—Show that the first day of a century cannot fall on Wednesday, Friday, or Sunday.

(Haugh's *Higher Arithmetic.*)

The civil year contains 365 days, unless the number of the year is a multiple of 4, in which case the year is a leap year, and contains 366 days. If, however, the number of the year is a multiple of 100, but not of 400, the year is not a leap year, and contains only 365 days.

Thus the year 1895 contains 365 days.

,,	,,	1896	,,	366 ,,
,,	,,	1900	,,	365 ,,
,,	,,	2000	,,	366 ,,
,,	,,	2100	,,	365 ,,
,,	,,	2400	,,	366 ,,

Hence the ordinary year contains 52 weeks + 1 day, and a leap year contains 52 weeks + 2 days.

Now the present century, ending with the year 2000, contains 75 ordinary years and 25 leap years; it therefore contains $\left(100\times52+\frac{75\times1+25\times2}{7}\right)$ weeks, that is, 5217 weeks + 6 days.

Now 1st January 1901 fell on Tuesday. Therefore 1st January 2001 will fall six days later than Tuesday; that is, will fall on Monday.

The next century contains 76 ordinary years and 24 leap years, and therefore contains $\left(100\times52+\frac{76\times1+24\times2}{7}\right)$ weeks; that is, 5217 weeks + 5 days. But we have seen that 1st January 2001

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will fall on Monday. Therefore 1st January 2101 will fall five days later than Monday.

Hence	1st January	2101	will fall on	Saturday.
Similarly	1st ,,	2201	,,	Thursday.
And	1st ,,	2301	,,	Tuesday.

But the century ending with the year 2400 will contain 25 leap years; therefore 1st January 2401 will fall six days later than Tuesday, that is, on Monday.

All the conditions will then be similar to those which will hold on 1st January 2001; so that the same order will be repeated until the 1st January 2801, when the same conditions will hold as on 1st January 2401; and so on for each succeeding period of four centuries.

Hence the first day of a century must fall on Monday, Tuesday, Thursday, or Saturday, and consequently cannot fall on Wednesday, Friday, or Sunday.

Constant Reader.—An equilateral triangle is described on a sphere of radius r, and each side of it is less than a third of the circumference of a great circle by a small difference k. Show that the square of a side of the polar triangle is $4\sqrt{3}kr$ very nearly. (M'Clelland and Preston's *Spherical Trigonometry*.)

Each of the sides $a=\beta=\gamma$ of the given triangle subtends at the centre of the sphere an angle $a=b=c=\left(\frac{2\pi}{3}-\frac{k}{r}\right)$ radians. Hence each of the angles $A'=B'=C'$ of the polar triangle is equal to $\left\{\pi-\left(\frac{2\pi}{3}-\frac{k}{r}\right)\right\}$ radians, that is equal to $\left(\frac{\pi}{3}+\frac{k}{r}\right)$ radians. Now if $a_1=\beta_1=\gamma_1$ be the lengths of the arcs which form the sides of the polar triangle we have

$$\cos\left(\frac{a_1}{r}\right)=\cos a'=\frac{\cos A'+\cos B'\cos C'}{\sin B'\sin C'};$$

$$\therefore\ \cos\left(\frac{a_1}{r}\right)=\frac{\cos A'+\cos^2 A'}{\sin^2 A'}=\frac{\cos A'(1+\cos A')}{1-\cos^2 A'};$$

$$\therefore\ \cos\left(\frac{a_1}{r}\right)=\frac{\cos A'}{1-\cos A'}.$$

But we have shown that $A'=\left(\frac{\pi}{3}+\frac{k}{r}\right)$ radians;

$$\therefore\ \cos\left(\frac{a_1}{r}\right)=\frac{\cos\left(\frac{\pi}{3}+\frac{k}{r}\right)}{1-\cos\left(\frac{\pi}{3}+\frac{k}{r}\right)}=\frac{\frac{1}{2}\cos\frac{k}{r}-\frac{\sqrt{3}}{2}\sin\frac{k}{r}}{1-\left(\frac{1}{2}\cos\frac{k}{r}-\frac{\sqrt{3}}{2}\sin\frac{k}{r}\right)}.$$

Since $\frac{k}{r}$ is a very small angle we may put $\cos\frac{k}{r}=1$ and $\sin\frac{k}{r}=\frac{k}{r}$.

$$\therefore\ \cos\left(\frac{a_1}{r}\right)=\frac{\frac{1}{2}-\frac{\sqrt{3}}{2}\frac{k}{r}}{\frac{1}{2}+\frac{\sqrt{3}}{2}\frac{k}{r}}=\frac{1-\sqrt{3}\frac{k}{r}}{1+\sqrt{3}\frac{k}{r}};$$

$$\therefore\ \cos\left(\frac{a_1}{r}\right)=\frac{\left(1-\sqrt{3}\frac{k}{r}\right)^2}{1-3\frac{k^2}{r^2}}=\frac{1-2\sqrt{3}\frac{k}{r}+3\frac{k^2}{r^2}}{1-3\frac{k^2}{r^2}}.$$

Hence, neglecting powers of $\frac{k}{r}$ higher than the first, we have

$$\cos\left(\frac{a_1}{r}\right)=1-2\sqrt{3}\frac{k}{r}\text{ very nearly.}$$

Again, since $\frac{k}{r}$ is small, $\frac{a_1}{r}$ must be a small angle.

Hence we may put $\cos\left(\frac{a_1}{r}\right)=1-\frac{1}{\lfloor 2}\left(\frac{a_1}{r}\right)^2$.

$$\therefore\ 1-\frac{1}{\lfloor 2}\left(\frac{a_1}{r}\right)^2=1-2\sqrt{3}\frac{k}{r}\text{ very nearly.}$$

$$\therefore\ a_1^2=4\sqrt{3}kr\text{ very nearly.}$$

Troubled.—Solve the equations

$$\begin{cases} x-y=2z, \\ x^2+y^2+z^2-\sqrt{yz+2x+xy}=21-\sqrt{14}. \end{cases}$$

From the second of the given equations, by a theorem proved in the chapter on Surds, we have

$$x^2+y^2+z^2=21,\text{ and }yz+zx+xy=14;$$

$$\therefore\ x^2+y^2+z^2+2(yz+zx+xy)=49;$$

$$\therefore\ (x+y+z)^2=49;$$

$$\therefore\ x+y+z=\pm 7\ .\ .\ .\ .\ .\ .\ .\ .\ (1)$$

The first of the given equations may be written in the form

$$x-y-2z=0.$$

Adding this to equation (1) we obtain

$$2x-z=\pm 7;$$

$$\therefore\ z=2x\mp 7.$$

Hence $$x+y+(2x\mp 7)=\pm 7;$$

$$\therefore\ y=\pm 14-3x.$$

But $$x^2+y^2+z^2=21;$$

$$\therefore\ x^2+(\pm 14-3x)^2+(2x\mp 7)^2=21;$$

$$\therefore\ 14x^2\mp 112x+224=0;$$

$$\therefore\ x^2\mp 8x+16=0;$$

$$\therefore\ (x\mp 4)^2=0;$$

$$\therefore\ x=\pm 4,\ y=\pm 2,\text{ and }z=\pm 1.$$

C. W.—Prove that the limit of $(\cos\theta)^{\frac{a^m}{\theta^m}}$ where m is an integer and θ is infinitely diminished is 0, $e^{\frac{-a^2}{2}}$ or 1 according as m is greater, equal to, or less than 2. (Lock's *Higher Trigonometry*.)

Let $y=(\cos\theta)^{\frac{a^m}{\theta^m}}$.

Then $\log_e y=\frac{a^m}{\theta^m}\cdot\log_e(\cos\theta)$;

$$\therefore\ \log_e y=\frac{a^m}{\theta^m}\log_e\{(1-\sin^2\theta)^{\frac{1}{2}}\}$$

$$=\tfrac{1}{2}\frac{a^m}{\theta^m}\log_e(1-\sin^2\theta).$$

Now $\log_e(1-x)=-\left(\frac{x}{1}+\frac{x^2}{2}+\frac{x^3}{3}+\ .\ .\ .\right)$, for all values of x less than unity. But $\sin^2\theta$ is less than unity,

$$\therefore\ \log_e(1-\sin^2\theta)=-\left(\frac{\sin^2\theta}{1}+\frac{\sin^4\theta}{2}+\ .\ .\ .\ .\right).$$

Hence $$\log_e y=-\tfrac{1}{2}\frac{a^m}{\theta^m}\left(\sin^2\theta+\frac{\sin^4\theta}{2}+\ .\ .\ .\ .\right)$$

$$=-\tfrac{1}{2}\frac{a^m}{\theta^{m-2}}\cdot\frac{\sin^2\theta}{\theta^2}\left(1+\frac{\sin^2\theta}{2}+\ .\ .\ .\ .\right).$$

Now each of the factors $\frac{\sin^2\theta}{\theta^2}$, $\left(1+\frac{\sin^2\theta}{2}+\ .\ .\ .\ .\right)$ becomes 1 when θ is infinitely diminished.

Hence, if m is an integer greater than 2,

$\log_e y=-\infty$, when θ is infinitely diminished;

$$\therefore\ y=e^{-\infty}=\frac{1}{e^{\infty}}=0.$$

Next, if $m=2$, we have

$\log_e y=-\frac{1}{2}a^2$ when θ is infinitely diminished;

$$\therefore\ y=e^{\frac{-a^2}{2}}.$$

Finally, when m is an integer less than 2 we have

$\log_e y=0$, when θ is infinitely diminished;

$$\therefore\ y=e^0=1.$$

Hence the limit of $(\cos\theta)^{\frac{a^m}{\theta^m}}$ where m is an integer and θ is infinitely diminished is 0, $e^{\frac{-a^2}{2}}$ or 1 according as m is greater, equal to, or less than 2.

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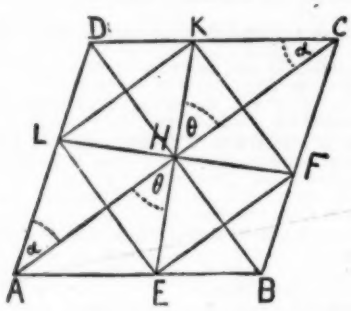

Let ABCD be the given rhombus and let H be the point of intersection of the diagonals. Denote each of the equal lengths AH, HC by d, and each of the equal angles DAH, DCH by α.

Suppose EHK, LHF are the diagonals of the inscribed rhombus. Then, since the diagonals of a rhombus bisect each other at right angles, the area of the rhombus EFKL is equal to $2KH \times HL$.

Let θ denote the angle KHC. Then, since KHL is a right angle, the angle LHA is equal to $\left(\frac{\pi}{2}-\theta\right)$.

Denote HK by x and HL by y.

Then the area of the rhombus $EFKL = 2xy$.

From the triangle KHC we have

$$\frac{KH}{HC}=\frac{\sin\alpha}{\sin(\theta+\alpha)},$$

$$\therefore \frac{x}{d}=\frac{\sin\alpha}{\sin(\theta+\alpha)} \quad \ldots\ldots\ldots \quad (1).$$

Again, from the triangle LHA we have

$$\frac{HL}{HA}=\frac{\sin\alpha}{\sin\left(\frac{\pi}{2}-\theta+\alpha\right)}=\frac{\sin\alpha}{\cos(\theta-\alpha)},$$

$$\therefore \frac{y}{d}=\frac{\sin\alpha}{\cos(\theta-\alpha)} \quad \ldots\ldots\ldots\ldots \quad (2).$$

Multiplying (1) by (2) we obtain

$$xy=\frac{d^2\sin^2\alpha}{\sin(\theta+\alpha)\cos(\theta-\alpha)}=\frac{2d^2\sin^2\alpha}{2\sin(\theta+\alpha)\cos(\theta-\alpha)},$$

Hence $xy=\dfrac{2d^2\sin^2\alpha}{\sin 2\theta+\sin 2\alpha}$.

Now d and α are constants, and 2α is positive and less than π, therefore xy is least when $\sin 2\theta$ is greatest, that is when $2\theta=\frac{\pi}{2}$.

Hence the inscribed rhombus is least when its diagonals bisect the angles between the diagonals of the given rhombus.

Cirsoid.—Find the values of θ between 0° and 360° which satisfy the equation $10\sin^2\theta=\operatorname{cotan}\theta$, and show that the imaginary values of $\sin\theta$ which satisfy the equation are

$$5^{\frac{1}{2}}\left\{\cos\left(45°+\frac{\alpha}{2}\right)\pm i\sin\left(45°+\frac{\alpha}{2}\right)\right\}\div\sqrt{10}$$

and

$$5^{\frac{1}{2}}\left\{\cos\left(135°-\frac{\alpha}{2}\right)\pm i\sin\left(135°-\frac{\alpha}{2}\right)\right\}\div\sqrt{10}$$

where α denotes the value of θ less than 90° which satisfies the given equation. (*B. of E.* 1905.)

Adding unity to the square of either side of the given equation we obtain the equation

$$100\sin^4\theta+1=1+\operatorname{cotan}^2\theta=\frac{1}{\sin^2\theta},$$

$$\therefore 100\sin^6\theta+\sin^2\theta-1=0,$$

$$\therefore (\sin^2\theta-0{\cdot}2)(100\sin^4\theta+20\sin^2\theta+5)=0,$$

$$\therefore \sin^2\theta=0{\cdot}2 \quad \ldots\ldots\ldots \quad (i).$$

or, $$100\sin^4+20\sin^2\theta+5=0 \quad \ldots\ldots \quad (ii).$$

From (i) we see that the two values of θ between 0° and 360° which satisfy the equation

$$\operatorname{cotan}\theta=2,$$

also satisfy the given equation.

Denoting the first of the postulated imaginary values of $\sin\theta$ by p and the second by q we have on squaring

$$p^2=\frac{\sqrt{5}}{10}\left\{\cos\left(45°+\frac{\alpha}{2}\right)\pm i\sin\left(45°+\frac{\alpha}{2}\right)\right\}^2.$$

$$\therefore p^2=\frac{\sqrt{5}}{10}\{\cos(90°+\alpha)\pm i\sin(90°+\alpha)\}.$$

$$\therefore p^2=\frac{\sqrt{5}}{10}\{-\sin\alpha\pm i\cos\alpha\} \quad \ldots\ldots \quad (iii).$$

Similarly $q^2=\frac{\sqrt{5}}{10}\{\cos(270°-\alpha)\pm i\sin(270°-\alpha)\}$.

$$\therefore q^2=\frac{\sqrt{5}}{10}\{-\sin\alpha\pm i(-\cos\alpha)\} \quad \ldots\ldots \quad (iv).$$

Therefore from (iii) and (iv), by addition, we have

$$p^2+q^2=-2\frac{\sqrt{5}}{10}\sin\alpha.$$

But from (i) we have $\sin\alpha=\sqrt{\frac{1}{5}}$.

$$\therefore p^2+q^2=-2\frac{\sqrt{5}}{10}\frac{1}{\sqrt{5}}=-\frac{1}{5}.$$

Again from (iii) and (iv) by multiplication we have

$$p^2q^2=\frac{\sqrt{5}}{10}\times\frac{\sqrt{5}}{10}(\sin^2\alpha+\cos^2\alpha)=\frac{5}{100}=\frac{1}{20}.$$

Now equation (ii), which gives the imaginary values of $\sin\theta$ which satisfy the given equation, may be written

$$(\sin^2\theta)^2+\frac{1}{5}(\sin^2\theta)+\frac{1}{20}=0.$$

Then, by the theory of quadratic equations, p^2, q^2 are the values of $\sin^2\theta$ which satisfy this equation.

Hence the expressions we have denoted by p and q are the values of $\sin\theta$ which satisfy the equation

$$100\sin^4\theta+20\sin^2\theta+5=0;$$

that is, are the imaginary values of $\sin\theta$ which satisfy the equation

$$10\sin^2\theta=\operatorname{cotan}\theta.$$

Scamp.—Prove that

$$e^{-1}=2\left(\frac{1}{\lfloor 3}+\frac{2}{\lfloor 5}+\frac{3}{\lfloor 7}+\ \ldots\right)$$

(Hall and Knight's *Algebra.*)

$$e^x=1+\frac{x}{\lfloor 1}+\frac{x^2}{\lfloor 2}+\frac{x^3}{\lfloor 3}+\frac{x^4}{\lfloor 4}+\ \ldots$$

and this is true for all values of x.

$$\therefore e^{-1}=1-\frac{1}{\lfloor 1}+\frac{1}{\lfloor 2}-\frac{1}{\lfloor 3}+\frac{1}{\lfloor 4}-\frac{1}{\lfloor 5}+\frac{1}{\lfloor 6}-\frac{1}{\lfloor 7}+\ \ldots$$

$$\therefore e^{-1}=(1-1)+\left(\frac{3}{3\lfloor 2}-\frac{1}{\lfloor 3}\right)+\left(\frac{5}{5\lfloor 4}-\frac{1}{\lfloor 5}\right)+\left(\frac{7}{7\lfloor 6}-\frac{1}{\lfloor 7}\right)+\ \ldots$$

$$=\frac{2}{\lfloor 3}+\frac{4}{\lfloor 5}+\frac{6}{\lfloor 7}+\ \ldots$$

$$=2\left(\frac{1}{\lfloor 3}+\frac{2}{\lfloor 5}+\frac{3}{\lfloor 7}+\ \ldots\right)$$

Bike.—Three rigid rods BC, CA, AB form an equilateral triangle in a horizontal plane, and have at their middle points three small, smooth rings, through which passes an endless string in tension T. Prove (by the Principle of Virtual Work) that the stress at A is equal to T. (*Tutorial Statics.*)

Let D, E, F opposite A, B, C respectively mark the positions of the three rings. Then the tension of the string can obviously be replaced by three external forces each equal to $2T\cos 30°$, and each acting at right angles to a side and towards the centre of the triangle.

From the symmetry of the system, the stress at A must be parallel to BC. Denote the stress by F.

Suppose the rod AB to revolve about B through a small angle $\delta\theta$. Then if we denote the length of BA by $2a$, we have by the Equation of Virtual Work,

$$2T\cos 30°a\delta\theta=F2a\cos 30°\delta\theta.$$

Therefore $F=T$.

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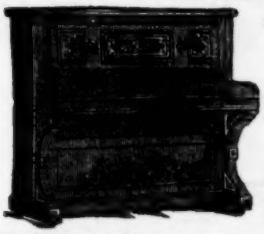

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